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PROPERTIES AND USES OF SHALES AND CLAYS, SOUTHWESTERN PENNSYLVANIA

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DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF
TOPOGRAPHIC AND GEOLOGIC SURVEY
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Kenneth J. Liles and the late Miles E. Tyrrell planned and supervised the test work done at the Tuscaloosa Metallurgy Research Center in Tuscaloosa, Alabama. They provided evaluations of the raw materials for potential uses based upon the results of the test work done at the laboratory. Liles also provided data for use in, and assisted in the preparation of, the section covering testing procedures.

**PROPERTIES AND USES
OF SHALES AND CLAYS,
SOUTHWESTERN PENNSYLVANIA**

by Bernard J. O'Neill, Jr., and John H. Barnes
Pennsylvania Geological Survey

PENNSYLVANIA GEOLOGICAL SURVEY

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PREFACE

Pennsylvania has ranked high among the states for many decades in the production of clay and shale raw materials for use in the manufacture of structural clay products, refractories, cement, lightweight aggregate, filler materials, and stoneware. One of the important regions from which these raw materials are mined within the commonwealth is southwestern Pennsylvania, which contributed more than 37 percent of the total tonnage mined in the commonwealth during the 16-year period from 1960 through 1975.

The Pennsylvania Bureau of Topographic and Geologic Survey within the Department of Environmental Resources has long been a supporter of the active clay-shale mineral industry in the commonwealth and is always ready to foster further development within this industry. To achieve these objectives, the Bureau plans and implements geologic investigations which are designed to aid those who are in search of sources of clay-shale raw materials for one or more uses. This report presents the results obtained from one of those investigations as a cooperative effort between the Pennsylvania Bureau of Topographic and Geologic Survey and the U. S. Bureau of Mines. The data in this report should be of particular interest to mining companies that are facing: (1) predictable exhaustion of reserves of clay-shale raw materials; (2) encroachment by other land uses; or (3) difficult zoning regulations. This report should also be of interest and benefit to land use planners, federal and state agencies, individual land owners, and all others who are interested in clay-shale raw materials.

We hope that the information in this report will contribute significantly to the further development of the clay-shale mineral industry in southwestern Pennsylvania.

ARTHUR A. SOLOW

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PROPERTIES AND USES OF SHALES AND CLAYS, SOUTHWESTERN PENNSYLVANIA

by

Bernard J. O'Neill, Jr., and John H. Barnes

ABSTRACT

Physical, firing, chemical, and X-ray mineralogical determinative tests were performed on 413 clay-shale samples from 42 different stratigraphic intervals occurring within 15 different geologic formations or groups in southwestern Pennsylvania. Preliminary evaluations indicate that 370 samples have a potential as a raw material for one or more of the following products: building brick, facing brick, floor brick, sewer pipe, drain tile, structural facing tile, nonload-bearing structural tile, lightweight aggregate, vitrified liner plates, and refractories.

The following exploration targets have been identified: the Brush Creek shale for lightweight aggregate; underclays in the Allegheny and Pottsville Groups for refractories; the Brookville and Lower Kittanning underclays for stoneware; the Clarion, Brookville, and Lower Freeport underclays for structural facing tile; the lower part of the Pittsburgh Formation for drain tile; the Kittanning, Glenshaw, Washington, and Uniontown Formations for sewer pipe; the Kittanning and Uniontown Formations for liner plates; and the Washington, Glenshaw, and Casselman Formations and the Brush Creek shale for floor brick. Many good exploration targets exist for building brick and facing brick.

The variables investigated and reported for each sample include: (1) unfired properties such as water of plasticity, drying shrinkage, workability, dry strength, drying effects, and pH; (2) fired properties such as color, hardness, total shrinkage, absorption, approximate porosity, approximate specific gravity (bulk density), firing range, bloating characteristics, and, as necessary, the pyrometric cone equivalent (P.C.E.); (3) quantitative X-ray mineralogy for quartz, mica, kaolinite, chlorite-vermiculite, montmorillonite, feldspar, and calcite; (4) chemical analyses; and (5) semiquantitative trace-element analyses. Geologic and geographic data are compiled for each sample.

Correlation studies were made using the following variables: (1) stratigraphic interval and use; (2) mineralogy and use; and (3) chemistry and use. The stratigraphic intervals that correlate well with each use are identified, and the better exploration targets listed. The results of the correlations between mineralogy and use and between chemistry and use indicate that most uses tolerate a wide range of concentration of most components, and that these are not practical exploration criteria. Physical and firing tests remain the only procedures for evaluating raw material.

INTRODUCTION

A cooperative program to evaluate the clays and shales in Pennsylvania for their potential uses was initiated in 1962 between the Bureau of Topographic and Geologic Survey, now within the Pennsylvania Department of Environmental Resources, and the U. S. Bureau of Mines within the United States Department of the Interior. Under this program, the Bureau of Topographic and Geologic Survey has been responsible for the planning and execution of the field work, for the determination of the mineralogy of the samples by X-ray diffraction, for some major- and minor-element analyses, and laboratory data. The U. S. Bureau of Mines has been responsible for performing the necessary physical and firing tests to determine the potential uses for each sample. Personnel at the U. S. Bureau of Mines Eastern Field Operations Center, located in Pittsburgh, Pennsylvania, coordinated their contribution to this program and administered the funding of costs incurred by their organization.

Phase I of the program was a reconnaissance during the early 1960's that resulted in the collection and testing of 151 samples from 41 counties and 51 geological units. Thirty-seven of those samples were from Allegheny, Armstrong, Butler, Fayette, Indiana, Lawrence, Somerset, Washington, and Westmoreland Counties, which make up part of the region designated as southwestern Pennsylvania.¹ The results of this work were published by the Bureau of Topographic and Geologic Survey as Mineral Resource Report 51 (O'Neill and others, 1965).

Phase II of the program concentrated on the clays and shales in southeastern Pennsylvania, where 159 samples from 15 counties and 19 geologic units were evaluated for potential uses. The results of that work were published by the Bureau of Topographic and Geologic Survey as Mineral Resource Report 63 (Hoover and others, 1971).

Phase III of the cooperative program concentrated on the clays and shales in southwestern Pennsylvania. During this phase, 413 clay and/or shale samples were collected and submitted to the U. S. Bureau of Mines Tuscaloosa Metallurgical Research Center in Tuscaloosa, Alabama, where the appropriate physical and firing tests were performed to determine potential uses. The results of these tests and the following information for each sample are presented in this report: (1) location on the geologic map on Plate 1, and by latitude and longitude on the data sheet; (2) geologic group and/or formation and stratigraphic interval from which the sample was collected as keyed to the generalized stratigraphic column on Plate 1; (3) stratigraphic thickness represented by the sample; (4) "chemical" analysis; and (5) "quantitative" X-ray mineralogy.

¹ Southwestern Pennsylvania, as defined for Mineral Resource Report 77, includes the following 12 counties: Allegheny, Armstrong, Beaver, Butler, Cambria, Fayette, Greene, Indiana, Lawrence, Somerset, Washington, and Westmoreland.

The chemical analyses were done at one of two laboratories. The Pennsylvania Bureau of Topographic and Geologic Survey was responsible for the major- and minor-element analyses for 253 samples, whereas the U. S. Geological Survey performed rapid-rock chemical analyses for major and minor oxides and routine emission-spectrographic analyses for 59 trace elements on the remaining 160 clay or shale samples at its Branch of Analytical Laboratories in Reston, Virginia. The U. S. Geological Survey work was conducted as a cooperative project between the U. S. Geological Survey and the Commonwealth of Pennsylvania under the U.S.G.S. Urban Studies Grant #14-08-0001-G-277.

Prior to the cooperative program started in 1962, many reports dealing with the clay and shale resources of Pennsylvania were published by the Bureau of Topographic and Geologic Survey. Several that merit the attention of those interested in these raw materials in southwestern Pennsylvania were authored by Shaw (1928) and Leighton (1932 and 1941). Other reports on this subject are listed in the references.

ACKNOWLEDGEMENTS

The contributions made by personnel of the U. S. Bureau of Mines are summarized on the back side of the front cover of this publication and are greatly appreciated.

The assistance of the U. S. Geological Survey is gratefully acknowledged. Under U.S.G.S. Urban Studies Grant #14-08-0001-G-277, their Branch of Analytical Laboratories performed rapid-rock chemical analyses and emission-spectrographic analyses for trace elements on 160 clay-shale samples.

Norman H. Suhr of the Mineral Constitution Laboratory, The Pennsylvania State University, assisted by providing an update on their atomic absorption procedures.

Robert C. Smith, II, our colleague in the Mineral Resources Division, provided invaluable help by setting up the atomic absorption procedures used for chemical analyses and by assisting in atomic absorption sample preparation and in interpretation of the data. He also served as reader of the report and improved it considerably by his constructive criticisms.

Appreciation is due also to Arthur A. Socolow, State Geologist of Pennsylvania, for his continued interest and advice during the various phases of this project.

GEOLOGIC SUMMARY FOR SOUTHWESTERN PENNSYLVANIA LOCATION

Southwestern Pennsylvania as defined for this report consists of the 12 counties shown in Figure 1. The important metropolitan area around Pitts-

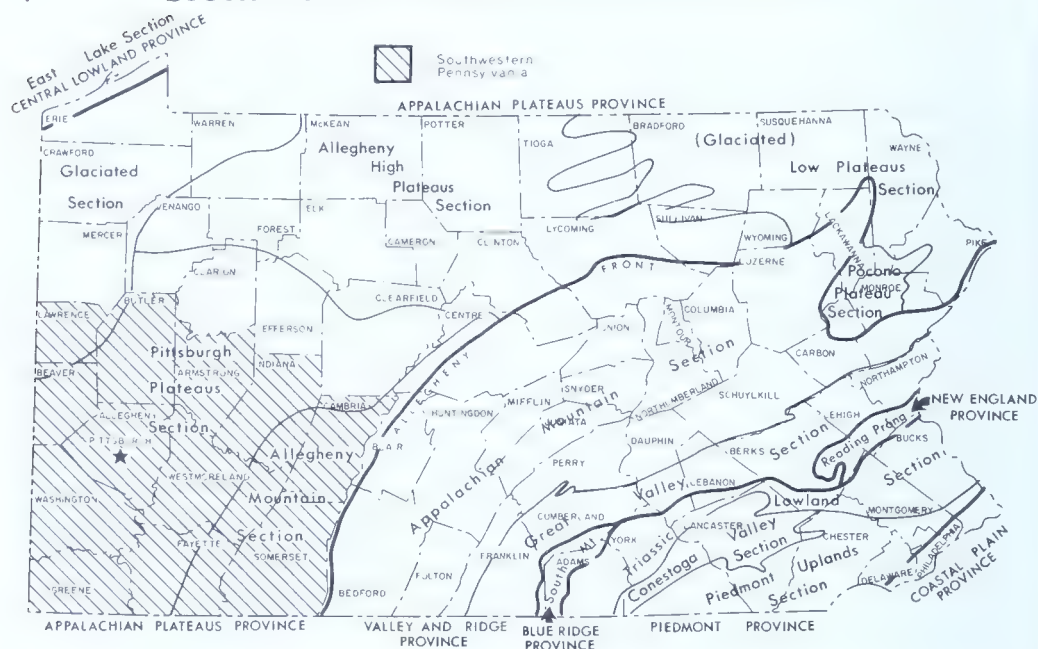


Figure 1. Map of the physiographic provinces of Pennsylvania showing the region of southwestern Pennsylvania.

burgh, which has a population exceeding 2.3 million, is located in the central and west-central parts of southwestern Pennsylvania. Second in population at 266,000 is the Johnstown metropolitan area, which includes Cambria and Somerset Counties, as reported by the U. S. Department of Commerce (1975).

PHYSIOGRAPHY

Pennsylvania is divided into seven physiographic provinces, as shown in Figure 1. Three of these physiographic provinces are subdivided into sections. Southwestern Pennsylvania lies within portions of the Glaciated, Pittsburgh Plateaus, and Allegheny Mountain sections of the Appalachian Plateaus province. Bounding the Appalachian Plateaus province on the east and separating it from the Valley and Ridge province is the Allegheny Front. The margin at the Front is abrupt and distinct in many areas because erosion, gradually wearing back the Plateau rocks from the east, has resulted in a steep erosional escarpment.

The Appalachian Plateaus province in southwestern Pennsylvania is generally characterized by a rolling highland which stretches westward from the Allegheny Front. The general elevation of the plateau, especially in the Pittsburgh Plateau section of this region, ranges from about 1200 to 1500 feet (370 to 460 m) above sea level. The major streams and intricately branching tributaries have carved the plateau into a maze of steep-sided val-

leys, and the major streams are now about 400 to 500 feet (120 to 150 m) below the uplands. It is along these narrow lowlands that most of the industrial development has taken place. Exceptions to this general topography occur in the Allegheny Mountain section of the Appalachian Plateaus province, where a number of conspicuous ridges trending northeast-southwest rise up to elevations exceeding 2700 feet (820 m). These ridges are commonly rocky, wooded areas that are underlain by resistant sandstones. In contrast, the undulating hilly country to the west in the Pittsburgh Plateaus section is underlain chiefly by the softer and less resistant rock types, such as shales and siltstones.

In the Glaciated section, which covers parts of Lawrence, Butler, and Beaver Counties in the northwestern portion of southwestern Pennsylvania, a veneer of glacial deposits blankets much of the surface. These deposits were left behind by a sequence of advancing and retreating glaciers that entered the region several times from about 500,000 to 11,000 years ago. These massive ice sheets modified the terrain by scraping and leveling the countryside, and by depositing the debris as hilly features under the ice and in layers in temporarily swollen lakes and rivers as the ice melted.

STRUCTURE

The geological structure in southwestern Pennsylvania is generally simple; much of the region is underlain by rock strata that are essentially horizontal, that is, dipping less than 5 degrees. Movements that have occurred within the earth's crust have caused some folding and tilting, resulting in a number of northeast-southwest-trending structures. One of these is the broad, flat, canoe-shaped trough known as the Pittsburgh-Huntington Basin, as shown in Figure 2. Its axis extends southwestward from Pittsburgh to Huntington, West Virginia. In Pennsylvania the deepest part of this trough is in the southwestern corner of the state, where the youngest rocks in southwestern Pennsylvania, the Dunkard Group, surface. The rocks surrounding this trough form an elliptical shape and at most points dip gently toward the lowest part of the trough.

Although the structure is generally simple, the rocks on the eastern limb of the trough are crumpled into folds that become more pronounced as the Allegheny Front is approached. These undulations, which are present in the Allegheny Mountain section of the Appalachian Plateaus province (Figure 1), are parallel and similar to the great folds east of the Allegheny Front, but are less intensely folded. Dips of bedding in this region range from about 5 to 20 degrees. Each fold west of the Allegheny Front lies lower than the one to the east so that geologic units that are well over 2000 feet above sea level at the Front lie below sea level in the central part of the Pittsburgh-Huntington Basin, as shown in cross section F-F' in Figure 2. Due to the vertical exaggeration in this cross section, the dips of the contacts separating

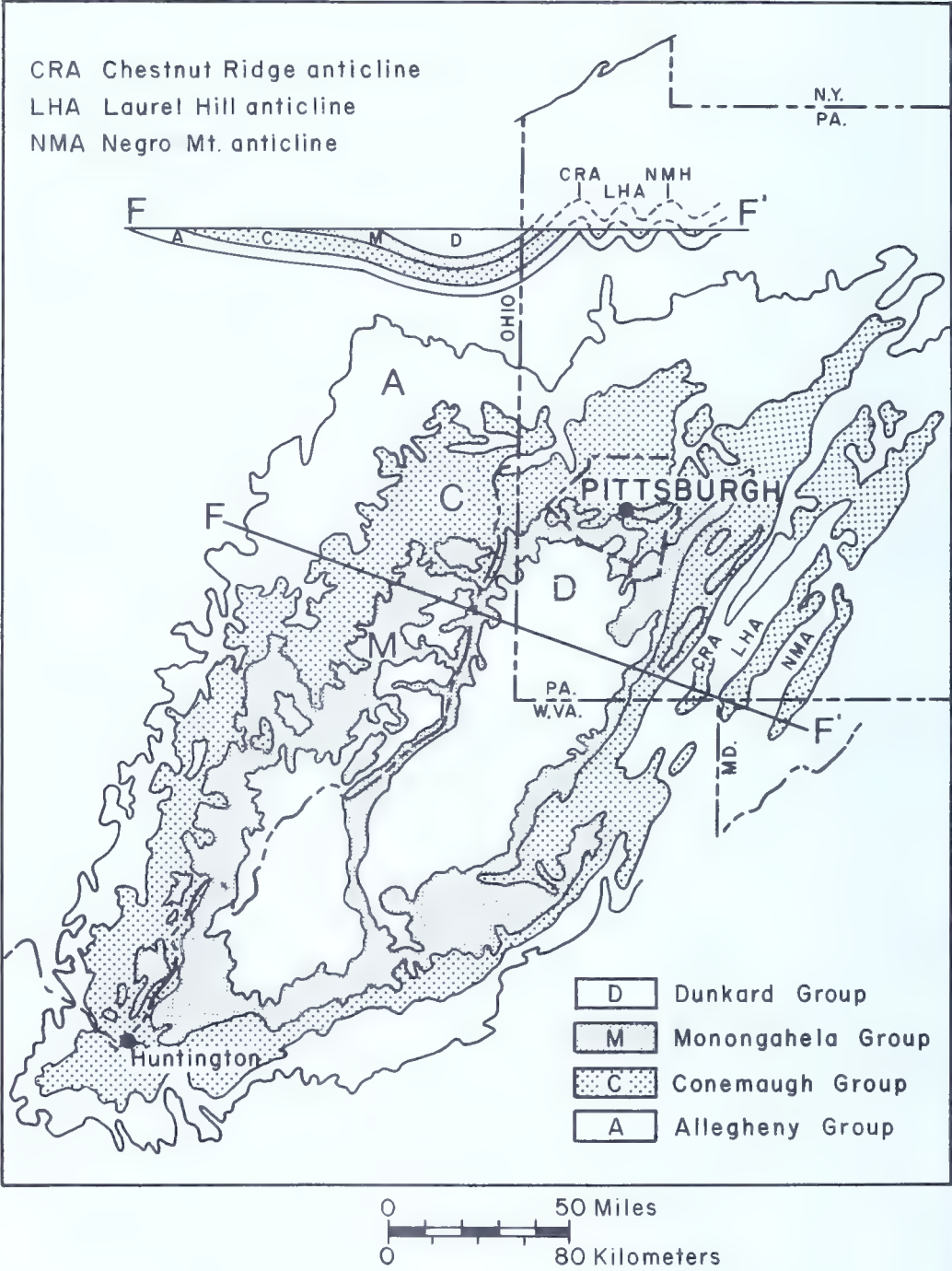


Figure 2. Geologic map of the Pittsburgh-Huntington Basin. Adapted from U.S. Geological Survey and U.S. Bureau of Mines (1968, Plate 2). The vertical distance in cross section F-F' is exaggerated.

the different geologic groups appear steeper than they actually are. The dips of contacts and bedding are usually similar.

The system of joints includes two major sets that dip steeply and are oriented at nearly right angles to each other. The frequency of joints usually varies according to rock type. In shales, joints are commonly close together, whereas in sandstones they are widely separated. Intermediate spacing is generally found in the other rock types. Faults occur in the area, but are not classified as major structural features.

STRATIGRAPHY

The exposed rocks represent a heterogeneous sequence of alternating and interfingering sediments that were deposited in aqueous environments, both marine and nonmarine, during the geologic interval from the Upper Devonian Period into the Permian Period. Their ages are estimated to range from 360 to 250 million years, respectively.

The types of rocks represented in this sequence are not restricted to clays and shales, but include other sedimentary types such as sandstones, siltstones, conglomerates, limestones, and coal, as shown in the stratigraphic column on Plate 1.

The systematic pattern of repetition of rock types, especially coals, in the stratigraphic sequence indicates that cyclic-like changes occurred in the environment as the sediments were deposited. For example, underclays are typically well developed beneath the coal seams.

Examination of the stratigraphic column on Plate 1 shows that the lower limit of some geological formations is defined by the base of a coal seam. For example, the bottom of the Pittsburgh coal marks the base of the Pittsburgh Formation. The underclay developed beneath a coal seam is therefore positioned and identified with the underlying geologic formation. In the case of the Pittsburgh coal, its underclay is placed in the Casselman Formation.

The geologic units that are exposed or crop out in southwestern Pennsylvania, listed in order from oldest to youngest, are: the Scherr, Foreknobs, and Catskill Formations within the Devonian System; the Rockwell Formation and undifferentiated marine units within the Mississippian-Devonian Systems; the Burgoon and Mauch Chunk Formations within the Mississippian System; the Pottsville, Allegheny, Conemaugh, and Monongahela Groups within the Pennsylvanian System; the Waynesburg Formation within the Permian-Pennsylvanian Systems; the Washington and Greene Formations within the Dunkard Group in the Permian System; and some surficial deposits in the Quaternary System.

The Scherr, Foreknobs, and Catskill Formations of the Devonian System, the Rockwell Formation and the undifferentiated marine units of the

Mississippian-Devonian Systems, and the Burgoon and Mauch Chunk Formations of the Mississippian System are exposed principally in the southeastern part of the area. A line along the base of the northwest flank of the northeast-trending Chestnut Hill anticline (Figure 2 and Plate 1) defines the northwest limit for these exposures. Exposures of the undifferentiated marine units of the Mississippian-Devonian Systems also occur within or adjacent to the valleys of the Shenango and Mahoning Rivers and some of their tributaries in the northwestern part of Lawrence County, within or adjacent to the valleys of the Allegheny River and Red Bank Creek in northern Armstrong County, and along a section of Bear Creek in northeastern Butler County. Although a considerable amount of the rock in this stratigraphic interval consists of sandstone, some formations such as the Scherr, Foreknobs, Catskill, Rockwell, and Mauch Chunk, and the undifferentiated marine units do have shale intervals which are of minable thickness in places and may be considered as potential raw-material sources. The combined Devonian-Mississippian rock section in southwestern Pennsylvania is more than 4400 feet (1340 m) thick. It is overlain unconformably by rocks of the Pottsville Group within the Pennsylvanian System, as shown in the stratigraphic column on Plate 1.

The Pottsville Group consists predominantly of sandstone and conglomerate and subordinate amounts of shale, limestone, and coal. Rocks of this group occur: (1) over large areas in Lawrence County; (2) in the valleys of the Allegheny and Beaver Rivers and some of their tributaries in northern Beaver, Butler, and Armstrong Counties; and (3) in places along the crests and flanks of structures such as Chestnut Ridge, Laurel Hill, and Negro Mountain. These structures are located within the Allegheny Mountain section of the Appalachian Plateaus province in the southeastern part of southwestern Pennsylvania (Figures 1 and 2).

Conformably above the Pottsville Group is the Allegheny Group, which consists of cyclic-like deposits of sandstones, siltstones, and shales, and subordinate amounts of limestone and coal. At the top is the Upper Freeport coal (see Plate 1, stratigraphic column), which is an important, minable coal in this region. The Allegheny Group is exposed in Lawrence County, in much of northern Beaver, Butler, and Armstrong Counties, within parts of the valleys of the Allegheny River in northern Allegheny County and the Kiskiminetas River in Westmoreland County, and along many of the structures that trend northeast through Fayette, Indiana, Somerset, and Cambria Counties. The Allegheny Group ranges from about 220 to 320 feet (65 to 100 m) in thickness.

A widely exposed unit in southwestern Pennsylvania is the Conemaugh Group, which overlies the Allegheny. It is made up of the Glenshaw and Casselman Formations. Only in Washington and Greene Counties are exposures sparse. The Conemaugh Group, which ranges in thickness from

about 500 to 960 feet (150 to 290 m) in this region, is composed of gray, red, and green shales, sandstones, thin coal seams, and thin units of limestone.

The widely mined Pittsburgh coal forms the base of the Monongahela Group, resting on uppermost Conemaugh rocks. The Monongahela Group crops out over much of the southern half of Allegheny County, a sizable portion of the northern and eastern parts of Washington County, parts of eastern Greene County, and along segments of the axis and flanks of folds that trend northeast through western Fayette County and in west and central Westmoreland County. Scattered areas underlain by the Monongahela Group also occur along structures in the southern parts of Indiana, Cambria, and Somerset Counties. The Monongahela consists principally of sandstones, limestones, shales, and coals. The stratigraphic thickness of this sequence ranges from 240 to 500 feet (70 to 150 m) in southwestern Pennsylvania.

The chief exposures of the Dunkard Group are in the southwestern part of the region. Rocks of the Greene and Washington Formations are well exposed in Washington and Greene Counties and in scattered areas in western Fayette County. Rocks of the Waynesburg Formation appear at the surface in areas within southern Allegheny County, southwestern Westmoreland County, the western half of Fayette County, and in Greene and Washington Counties. The Dunkard Group consists of sandstones, shales, limestones, and subordinate coals. The thickness of this sequence reaches a maximum of 855 feet (260 m) in southwestern Pennsylvania. A Quaternary mantle covers parts of the region, and some of this mantle consists of clay.

CLAY-SHALE PRODUCTION IN SOUTHWESTERN PENNSYLVANIA

The mining and processing of clay and shale raw materials in southwestern Pennsylvania have made significant contributions over the years to the mineral industry of the commonwealth. Each of the 12 counties in southwestern Pennsylvania has contributed clay or shale raw materials in the past for use in the manufacture of one or more of the following: (1) refractories (fire brick and block); (2) structural clay products such as brick and tile; or (3) portland cement (Table 1).

The two principal types of raw materials produced in this region as classified in Table 1 are: (1) fireclay, and (2) common or miscellaneous clay and shale. The underclays to coal measures constitute the source of supply for fireclays or refractories in Pennsylvania. Some underclays also are being used to produce structural clay products. Common or miscellaneous clays and shales are more widespread than fireclays, but the quality and characteristics of miscellaneous clays are extremely variable, necessitating careful

Table 1. *Clay and Shale Produced in Southwestern Pennsylvania, by Use*

	FIRECLAY	MISCELLANEOUS CLAY AND SHALE		
	Fire brick and block	Common brick	Structural tile	Portland cement
Allegheny		X		
Armstrong	X	X	X	
Beaver	X	X		
Butler				X
Cambria	X	X		
Fayette	X	X		
Greene		X		
Indiana	X			
Lawrence	X	X	X	X
Somerset	X	X		
Washington		X		
Westmoreland		X		

work to locate deposits suitable for use in specific products such as light-weight aggregate, cement, and some structural clay products.

The data presented in Table 2 show that the clay and shale produced in southwestern Pennsylvania during the period from 1960 through 1975 represented from 32.7 to 42.7 percent of the state's annual tonnage; the dollar values ranged from 20.1 to 49.4 percent of the state's total. The tonnage and dollar values for the clays and shales sold or used in southwestern Pennsylvania each year from 1960 through 1975 are shown graphically in Figure 3. The peak output of almost 1.4 million short tons (1.26 million MT) occurred in 1965, whereas the maximum dollar value of more than 9.6 million dollars was recorded in 1969. Production since 1965 has in general decreased, although some reversals in the trend are evident. A drastic plunge in dollar values occurred after 1969, and a levelling off at between 3 and 4 million dollars occurred between 1971 and 1975.

The declines in production and dollar value are due to several factors. Some of the more important are: (1) a slump in the construction industry which affected the demand for structural clay products; (2) the increase in production costs caused by the rise in fuel costs; and (3) the shift in the steel-making industry from the open hearth to the basic oxygen process beginning about 1960. This shift increased the demand for refractories that could withstand higher operating temperatures and more severe operating conditions, and thus favored the substitution of basic refractories (magnesite, dead-burned dolomite, and chrome ore) over the alumina refractories (fire clays) in furnaces.

The decrease in demand for clay and shale caused by these factors has probably bottomed out, and the markets for products manufactured from these raw materials can be expected to stabilize or increase. The long-range

Table 2. Clay and Shale Production in Southwestern Pennsylvania and Its Share of the State's Total (1960-1975)

	Southwestern Pennsylvania				Pennsylvania	
	PRODUCTION		VALUE		PRODUCTION	VALUE
	Short tons (thousands)	Percent of state total	Thousands of dollars	Percent of state total	Short tons (thousands)	Thousands of dollars
1960	1344	37.8	7610	46.0	3557	16536
1961	1010	33.7	5807	40.3	2999	14402
1962	960	33.2	4847	37.8	2893	12815
1963	1125	35.3	5525	37.5	3191	14717
1964	1225	38.4	5679	35.9	3187	15814
1965	1398	41.2	7638	43.2	3394	17687
1966	1330	40.4	5359	31.5	3293	17033
1967	1173	39.2	6616	39.6	2994	16703
1968	1191	39.3	7645	43.2	3034	17679
1969	989	36.3	9695	49.4	2727	19637
1970	904	33.9	6208	39.2	2665	15845
1971	824	35.4	3017	33.7	2325	8940
1972	858	32.7	3845	24.3	2627	15829
1973	1051	35.3	3780	22.7	2975	16664
1974	911	42.7	3322	20.1	2132	16496
1975	648	33.3	2999	21.9	1945	13672

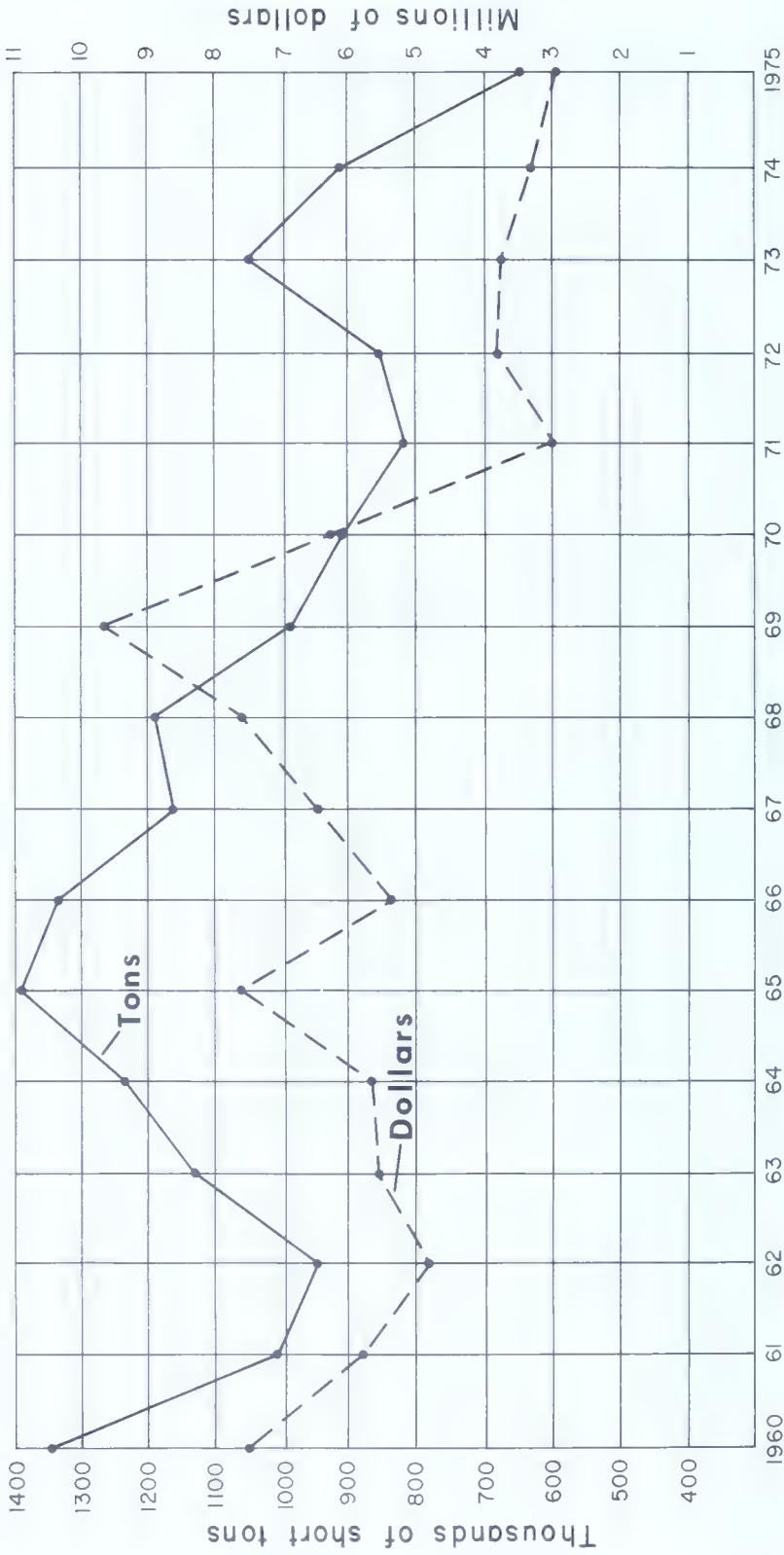


Figure 3. Tonnage and dollar values for the clays and shales sold or used in southwestern Pennsylvania (1960-1975). One short ton equals 0.9 metric ton.

demands for clay and shale required for lightweight aggregate and portland cement appear bright. Although demands for heavy structural clay products will continue, these materials might face strong competition from substitutes such as cement, wood, glass, plastics, and aluminum. However, the effect of world oil and energy supplies on the plastics and aluminum industries is difficult to predict.

Clay shortages could develop in southwestern Pennsylvania because of the failure to identify and protect strategically located deposits. The evaluations of the geologic formations and units in this report will prove useful to long-range planners and other interested parties in resolving problems that will undoubtedly confront them as urban expansion continues.

SAMPLING AND TESTING PROCEDURES

GENERAL STATEMENT

The primary purpose of this study was the evaluation of clay and shale samples collected from as many geologic formations as possible in southwestern Pennsylvania. A total of 413 samples from 34 different stratigraphic intervals occurring within 15 different geologic formations or groups was collected by the staff of the Pennsylvania Bureau of Topographic and Geologic Survey. These samples were submitted to the Tuscaloosa Metallurgy Research Laboratory of the U. S. Bureau of Mines in Tuscaloosa, Alabama, where physical and firing tests were made to evaluate them for potential uses. The sampling and testing procedures followed during these phases of the study are described below.

SAMPLING TECHNIQUES

Samples were collected from natural exposures, roadcuts, quarries, coal strippings, and drill core. The minimum weight for each sample was 10 pounds (4.5 kg). Whenever possible, a channel sample of the clay-shale material was collected. Where conditions precluded channel sampling, a representative sample or a grab sample was obtained. Each sample location was assigned a number and plotted on a 7-1/2-minute topographic map for the reference file, and notes were made describing the sampled material and its geologic environment. The locations for the 413 shale and clay samples are shown on Plate 1. The detailed description for each sample is included in the "Sample Data and Test Results" section of this report.

TESTING PROCEDURES

The wide variety of products made from industrial shales and clays classes them as a major industrial raw material. Many clays and shales can

be used in the crude state, but others must be beneficiated or refined to remove objectionable impurities. For each use, the raw material must possess certain properties, and what is considered to be a critical property in a shale or clay for one product may be wholly unimportant in another. To test each sample for all uses would be impractical, and, fortunately, is unnecessary for preliminary appraisals. The preliminary testing is exploratory and gives clay type, properties, and potential uses. Such evaluations are valuable in that they identify specific sites where further test work on promising clay-shale raw materials is warranted.

The flow chart followed in making preliminary evaluations of clays and shales is shown in Figure 4. A 10-pound (4.5-kg) sample of the material is dried at 230°F (110°C) and ground to pass a 20-mesh sieve. One hundred grams of the powdered material is tempered with water to form a plastic mass. The water of plasticity and workability are noted. Small test specimens (1-1/2 x 2-1/2 x 1/4 inch, or 3.8 x 6.4 x 0.6 cm) are extruded, and, after being marked for shrinkage, are dried overnight at 140°F (60°C). The dried specimens are placed in an electric laboratory kiln. The temperature is raised to 1800°F (982°C) in about 4 hours and remains at that temperature for a 1-hour soak period. The kiln is then shut off and allowed to cool. Test specimens are subsequently fired in 100°F (38°C) intervals from 1900 to

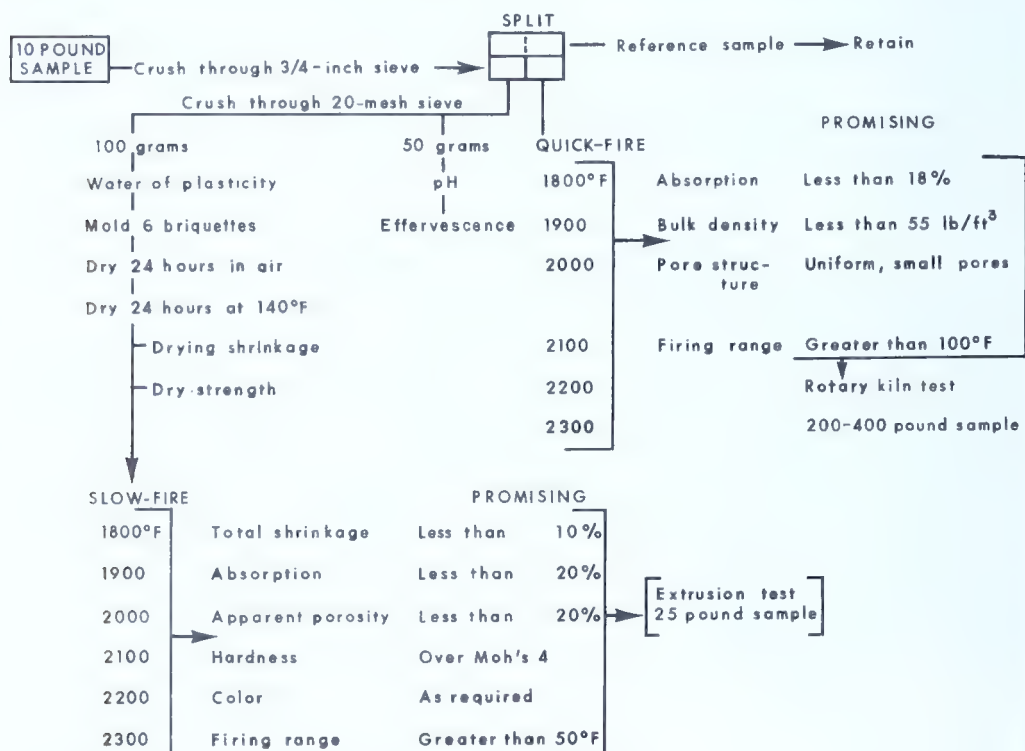


Figure 4. Flow chart for preliminary evaluation of clays and shales.

2300°F (1038 to 1260°C), and there is a 1-hour soak at each 100°F (38°C) interval. This range includes most of the firing temperatures prevalent in the structural clay products industry, but the top temperature is not high enough to adequately evaluate refractory products.

From the preliminary tests, the following data are collected: characteristics of the unfired material, including color, pH, water of plasticity, drying shrinkage, and dry strength; and characteristics of the fired material, including total shrinkage, color, hardness, absorption, apparent porosity, bulk density, and bloating tendency. The bloating tendency is determined by quick-firing (see lightweight aggregate section) a few 1/2-inch (1.3-cm) lumps of each material at 2100°F (1150°C).

As a rule, the information obtained from the preliminary tests is adequate for general appraisal, even though the results obtained in the laboratory may differ from those done on an industrial scale.

CRITERIA USED IN EVALUATING CLAYS AND SHALES

STRUCTURAL CLAY PRODUCTS

Structural clay products are commonly formed by stiff-mud extrusion. The ideal clay or shale should have moderate plasticity and good workability, high dry strength, a long vitrification temperature range, total shrinkage of less than 10 percent, and a fired color that will meet market specifications. Because few clays or shales are ideal in all properties, it is often necessary for the manufacturer to develop blends fitted to his process and product. Some criteria used for evaluating materials for the manufacture of structural clay products are given in Table 3.

REFRACTORY CLAYS

The most important property to be considered in appraising refractory clays is their capacity to endure high temperatures. Other properties must be considered but vary in importance with the method of fabrication and the specific use. Blends of clays are used in making most refractory products, and the ware can be formed by dry pressing, extruding, casting, or hand molding. The desirable properties of the blending materials, such as plasticity, green strength (wet and dry), and drying characteristics, will vary to some extent, depending on the method of fabrication used.

Some of the more common names associated with refractory clays are flint, semiflint, semiplastic, plastic, high-alumina, coal-measure fire clays, and refractory bond clays. Such names as high duty, intermediate or moder-

Table 3. Some Criteria Used in Evaluating Clays and Shales for Structural Clay Products and Stoneware

Product	Maturing temperature, °F	Absorption of water (maximum percent)	Forming methods ¹
Building brick			
Grade SW	1900-2300	17	E, DP, SM
Grade MW	1900-2150	22	E, DP, SM
Grade NW	1800-2000	No limit	E, DP, SM
Facing brick			
Type FBX	1900-2300	17-22	E, DP, SM
Type FBS	1900-2300	17-22	E, DP, SM
Type FBA	1900-2300	17-22	E, DP, SM
Floor brick			
Type T	2100-2300	10	E, DP
Type H	2150-2350	6	E
Type M	2200-2500	2	E
Type L	2200-2500	1	E
Liner plates	2000-2300	6	E
Sewer pipe			
Standard	2000-2300	8	E
Drain tile			
Standard	1800-2100	13	E
Structural tile			
Facing	2100-2300	9	E
Load-bearing	1900-2300	16	E
Non-load-bearing	1800-2100	28	E
Stoneware	2250-2350	2	E, J

¹ E = extrusion; DP = dry-press; SM = soft-mud; J = jigger.

Additional general criteria used in preliminary clay evaluations are as follows:

	Extrusion	Soft-mud	Dry-press
Workability	plastic	short	short
Dry strength	good	good	fair
Dry shrinkage	<6.0%	<5%	<2.5%
Total shrinkage	<10.0%	<7.5%	<5.0%

Effervescence with HCl and efflorescence in drying indicate the presence of deleterious calcium compounds which necessitate precautionary measures in processing.

ate duty, and low duty are used by the trade to indicate the class of refractory.

In a preliminary evaluation of a refractory clay, the general testing procedure distinguishes the plastic clays from the nonplastic clays and gives other properties such as shrinkage, absorption, and apparent specific gravity. The most essential test for these clays is the pyrometric cone equivalent (PCE) test. This test will distinguish refractory clays from nonrefractory materials and also indicate the maximum temperature at which the clay can be used.

The criteria given in this report for appraising the refractory clays are based largely on the pyrometric cone equivalents as shown in Table 4.

Table 4. *Standard Classification of Fireclay Refractory Brick as Proposed by A.S.T.M. C27-70*

Class	Pyrometric cone equivalent
Super duty	33
High duty	31½-32
Intermediate duty	29-31
Low duty	15-28

LIGHTWEIGHT AGGREGATE

The process of expanding clays and shales in a rotary kiln to produce lightweight aggregate for concrete was patented by Stephen Hayde in 1917; however, demand for the product was limited and the industry did not begin to expand until the construction boom following World War II. According to U. S. Bureau of Mines statistics, about 4 million tons of miscellaneous clays was used nationwide for the manufacture of lightweight aggregate during 1956; this figure had increased to about 12 million tons in 1973. During 1974 and 1975, however, a downturn in the rate of construction lowered the demand for lightweight aggregate from the high recorded for 1973.

Several factors contributed to the rapid increase in lightweight aggregate production over the 17-year span 1956-1973, but the most important was undoubtedly the improvement in quality and uniformity of material delivered to the consumer. In the early years, control over the raw materials and the processing was minimal; as a result, much of the aggregate entering the market was of poor quality. Today, all steps in manufacture are closely controlled. Bloating properties of the raw materials are determined well in advance of mining. The kiln feed is carefully sized and the firing temperature is kept under constant surveillance. In addition, the size gradation of the product is adjusted to meet both American Society for Testing Materials (A.S.T.M.) specifications and those of the consumer.

The use of controls over each stage in the process makes it possible for the manufacturer of lightweight aggregate to deliver a uniform product having the following unique properties:

1. Lightweight—Depending on the aggregate and the strength required, concrete containing lightweight aggregate will weigh from 90 to 115 pcf (pounds per cubic foot) (1440 to 1840 kg/m³). In contrast, sand and gravel concrete weighs about 150 pcf (2400 kg/m³).

2. Strength—In a properly designed mix, lightweight aggregate will produce concrete that develops 5,000 pounds per square inch (350 kg/cm^2) compressive strength in 28 days.
3. Toughness—The modulus of elasticity of lightweight concrete is about one half that of heavy concrete; as a result, it is tougher and more shock resistant.
4. Insulation—In thermal insulating value, an 8-inch- (20-cm-) thick wall of lightweight block is equal to a heavy concrete wall 34 inches (85 cm) thick.
5. Stability—Well-fired lightweight aggregate is chemically inert; it will not cause iron staining, and it is not attacked by salt water.

Preliminary (Quick-Firing) Tests

Lightweight aggregate is produced by expanding clay or shale in a rotary kiln or by sintering on a moving hearth. Clays that bloat between 1800 and 2200°F (980 and 1205°C) are preferred for rotary-kiln processing. A long temperature range between initial bloating and melting is required; a range of 100°F (38°C) is generally considered essential for rotary-kiln processing. The shales should crush to irregular lumps with no flaking. Fines generally cause ring formation in the kilns so they must be removed from the feed. As a result, the minus-4-mesh material should not exceed 20 percent. The expanded particles should have a strong cell structure and a vitreous outer shell. In the sintering process, clay fines are mixed with a combustible material and pelletized for firing on the moving hearth. The clay should vitrify with slight expansion at a temperature of 2200°F (1205°C) or below.

Quick-firing tests are used to determine the bloating characteristics of clays and shales within the range of commercial rotary-kiln operating temperatures, starting just under bloating and continuing until overbloating or fusion. A kiln preheated to 1800°F (980°C) is used in making the quick-firing tests. About a dozen 1/2-inch (1.3-cm) lumps of the material are placed in the furnace on a refractory boat; after 15 minutes at temperature, the material is removed from the furnace. The procedure is repeated at 100°F (38°C) intervals to 2300°F (1260°C), or until the material shows signs of melting. On the basis of quick-firing data, the material tested can be classified according to its potential for use in the manufacture of lightweight aggregate as follows:

Promising—A material characterized by good cell structure encased in an impervious shell; one that will produce a coarse aggregate weighing less than 55 pcf (880 kg/m^3), at a temperature not over 2200°F (1205°C), and has a processing range of at least 100°F (38°C) between initial bloating and overbloating.

Marginal—A clay that will bloat to specifications, but is refractory; one that may be a mixture of bloating and nonbloating materials; one that ap-

pears to have a short bloating range, or has poor crushing characteristics. Not suitable—Materials that are nonbloaters; those high in lime, and those having a poor cell structure.

The quick-firing tests give data useful in appraising clays or shales as raw materials for lightweight aggregate, but the final evaluation must be based on data obtained from tests designed to approximate commercial operating conditions.

Rotary-Kiln Tests

Bulk samples weighing from 200 to 400 pounds (90 to 180 kg) are spread in trays and dried overnight at 160°F (70°C). The dried samples are crushed in a swing hammer mill to pass a 3/4-inch (1.9-cm) sieve. Minus 3/4-inch (1.9-cm) plus-4-mesh material is used as kiln feed; the minus-4-mesh material is rejected as crushing loss.

A gas-fired rotary kiln 14 feet (4.2 m) long, having an inside diameter of 16 inches (40 cm), is used for testing samples found to be promising for lightweight aggregate in the preliminary tests. Raw material is charged at a rate of about 100 pounds (45 kg) per hour. The temperature of material passing through the hot zone is determined by an optical pyrometer.

The kiln is heated to the temperature indicated in preliminary tests as being required to produce aggregate weighing 55 to 65 pounds per cubic foot (880 to 1040 kg/m³). The temperature is raised gradually until the loose-pour weight of the uncrushed bloated material is in the range of 40 to 45 pounds per cubic foot (640 to 720 kg/m³). This temperature is maintained until about 150 pounds (70 kg) of expanded material is produced, and then the temperature is raised until sticking commences; this temperature is the upper limit of the firing range.

One half of each expanded sample is crushed to pass a 3/4-inch (1.9-cm) sieve, and is then separated on stacked screens into the size fractions required for coarse aggregate. The other half of the sample is crushed to pass a 3/4-inch (1.9-cm) sieve, and is separated into the size fractions required for fine aggregate. Screen analyses and loose-pour weights of each fraction are reported.

The sized aggregate must be tested in lightweight concrete before final evaluation is made.

CEMENT

Portland cement is a clinkered mixture of an argillaceous material and a calcareous material. The argillaceous material is usually clay or shale. The calcareous material may be limestone, cement rock, or marine shells. The stone-to-clay ratio should be about 3 to 1; frequently, mill scale is added to adjust the mix to approximate this ratio.

The use of shale and clay materials in the manufacture of portland cement depends upon their chemistry, because when blended with a limestone, the mix must meet certain chemical specifications. Persons in the industry who are in search of clays or shales for a cement mix should review the chemical analysis presented in Table 12.

QUANTITATIVE X-RAY MINERALOGY

GENERAL STATEMENT

Quantitative X-ray diffraction mineral determinations of all the samples collected during this investigation were undertaken as a continuation of the program begun by O'Neill and others (1965) and continued by Hoover and others (1971). As noted by Lapham in O'Neill and others (1965, p. 21),

Quantitative X-ray mineral analysis of the clays and shales of Pennsylvania was undertaken for two reasons: (1) to correlate mineral content and potential use in the hope of establishing criteria useful in the future exploitation of these deposits, and (2) to obtain basic information concerning mineral variation in Pennsylvania shales and clays.

The previous investigations have shown some correlation between mineralogical composition and potential uses (see O'Neill and others, 1965, p. 410-422; Hoover and others, 1971, p. 305-308). However, the mineralogical ranges for many uses overlap. Other factors, such as grain size and chemistry, interact with mineralogy in determining the physical properties of a material and, hence, its use. Despite the overlaps, this aspect of the clay and shale investigation was continued in order to: (1) attempt additional correlations using limited computer facilities; (2) further define the mineralogical ranges to which some uses appear to be limited; (3) add to the existing data base on the mineralogic composition of shales and clays in Pennsylvania.

As in the two previous investigations cited, the large number of samples, together with time limitations, necessitated the implementation of X-ray diffraction procedures that involve a large number of compromises and assumptions. The procedures followed differed from those followed previously because of the acquisition of different X-ray diffraction equipment. Because of these changes, the procedures will be discussed in some detail.

ANALYTICAL PROBLEMS

The problems associated with quantitative X-ray clay mineralogy were discussed by Lapham in O'Neill and others (1965, p. 21-25). Problems inherent in any attempt to quantify X-ray diffraction data include: (1) differential absorption of primary X-rays and increase in background, which is dependent on the chemical composition of the sample; (2) differences in the efficiency with which the mineral diffracts X-rays, the efficiency being dependent on: (a) the degree of crystallinity of the mineral; (b) the orientation

and size of the mineral grains; and (c) the orientation and size of grains of other minerals in the sample; and (3) instrument stability.

The quantification of diffraction data from clay minerals is made particularly difficult because the chemical and physical properties of these minerals aggravate the problems listed in item 2 above in the following ways:

(1) The crystallinity of some clay minerals can vary widely, because of chemical substitutions or vacant sites in the crystal structure. A well-crystallized mineral produces a sharp, intense diffraction peak, whereas a poorly crystallized one produces a broad peak of lower intensity. To help overcome this problem, intensity was measured as the area under the peak, rather than as peak height. This, theoretically, should yield a more accurate representation of the total intensity and, hence, concentration.

(2) Ideally, all grains in an X-ray diffraction mount should be of the same size and randomly oriented. In practice, two problems arise. The clay and shale samples contain minerals that have a wide range of hardness. When crushed, the harder minerals, such as quartz, resist breakup and persist as larger grains than the other minerals. Too much grinding, however, destroys the structure of the clay minerals, broadening and eliminating their diffraction peaks. Because of this possibility, excessive grinding was avoided and larger quartz grains were tolerated. Because all samples were treated in the same manner, and standards were given treatment that is comparable, problems related to this effect are believed to have been minimized.

The clay minerals that make up most of each sample consist of tiny flakes that become lined up parallel to the surface of an X-ray sample holder when the sample is compressed. This causes increased diffraction intensity for the basal spacings of the oriented minerals and decreased intensity for other minerals that can be masked by these oriented flakes. To reduce this effect, sample holders that are loaded from the back were used. As before, however, the principal action to resolve this problem was to treat all samples and standards in the same way.

The other problems associated with the quantification of X-ray diffraction data are probably no more serious for clay minerals than for any others. The possibility of instrument instability was checked by measuring diffraction intensity using a quartz standard at the beginning and end of each day. Negligible daily drift was noted.

CALIBRATION

Sixteen standard mixtures were prepared using the eight mineral species or groups listed in Table 5. These materials were selected on the basis of purity and, when possible, the degree to which they might be representative of the mineral varieties encountered in the samples. The mixtures that were prepared covered the ranges of minerals in shales and clays reported in previous studies (O'Neill and others, 1965; Hoover and others, 1971). The concentrations chosen for each mixture are listed in Table 6.

Table 5. Mineral Components of Standard Mixtures

Mineral species or group	Location	Comments
Feldspar	Bancroft, Ontario	Albite
Calcite	Chihuahua, Mexico	"Iceland Spar"
Chlorite	Kline's quarry, York County, Pennsylvania	Chamosite (Barnes, 1978)
Mica	Fithian, Illinois	Illite, minor quartz*
Kaolinite	Bath, South Carolina	A.P.I. Kaolinite #7, minor quartz*
Montmorillonite	Belle Fourche, South Dakota	A.P.I. Montmorillonite #27, 001 peak at 13.23 Å
Quartz	Arkansas	Novaculite
Vermiculite	Brinton's quarry, Chester County, Pennsylvania	Minor muscovite

*Mica standard contains 4.2 ± .5% quartz, and kaolinite standard contains 3% quartz by method of standard addition.

Table 6. Standard Mixtures for Quantitative X-ray Diffraction, Given in Weight Percent

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Chlorite	20	19	0	10	3	0	3	8	2	14	0	0	0	4	2	0
Vermiculite	3	8	10	6	1	0	1	0	1	1	0	0	1	0	2	3
Montmorillonite	13	15	9	0	20	17	3	8	1	1	3	0	2	1	4	6
Quartz*	38.4	27.2	19.9	33.5	60.4	64.8	70.8	50.6	8.5	8.0	11.6	16.8	1.7	9.1	16.7	2.6
Mica *	0	21.1	44.1	34.5	4.8	18.2	14.4	9.6	76.6	68.0	59.4	3.8	0	49.8	24.0	28.7
Feldspar	8	0	17	13	3	0	1	9	3	5	26	27	24	6	10	10
Kaolinite*	13.6	9.7	0	0	6.8	0	4.9	4.9	5.8	0	0	51.4	55.3	30.1	21.3	41.7
Calcite	4	0	0	3	1	0	2	10	2	3	0	1	16	0	20	8
Totals:	100.0	100.0	100.0	100.0	100.0	100.0	100.1	100.1	99.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Values corrected for quartz impurity in mica and kaolinite.

An X-ray diffractometer scan of each mineral component for the standard mixtures was run to determine its purity and to locate characteristic diffraction peaks of reasonable intensity that have a minimum of interference problems from other commonly occurring minerals. The possibility of potential interference problems was further checked by examination of the diffraction data listed by Grim (1968) and by the JCPDS-International Centre for Diffraction Data. Because of the coincidence of the major diffraction peaks of kaolinite and chlorite at 7Å, and of chlorite, vermiculite, and expanded montmorillonite at 14Å, it was decided that the intensities of these peaks would be measured and that the presence of each mineral would be verified by the measurement of a much less intense, but unique, peak. A list of the peaks selected for the quantitative determinations is presented in Table 7.

Table 7. X-ray Diffraction Peaks Selected for Quantitative Determinations

No.	Mineral	hkl	d(Å)	°2θ Scanned (CuKα)
1	Quartz	100	4.26	20.40–21.30
2	Calcite	104	3.035	28.90–30.00
3	Mica	001	10.0	7.50–9.60
4	Feldspar	002, +	3.19	27.30–28.60
5	Kaolinite	20 $\bar{2}$, 1 $\bar{3}$ 1, 11 $\bar{3}$	2.34	38.00–38.90
6	Kaolinite + chlorite	00 \bar{l}	7	11.00–13.20
7*	Vermiculite	0·0·10	2.87	30.90–31.30
8	Chlorite + vermiculite + montmorillonite	00 \bar{l}	14	5.00–7.70
9	Chlorite	005, 024	2.83	31.40–31.90
10†	Montmorillonite	007	2.09	43.00–43.40

* Shifts of the basal dimensions of vermiculite could result in under-representation of this mineral in some samples.

† Montmorillonite peak deleted after initial testing.

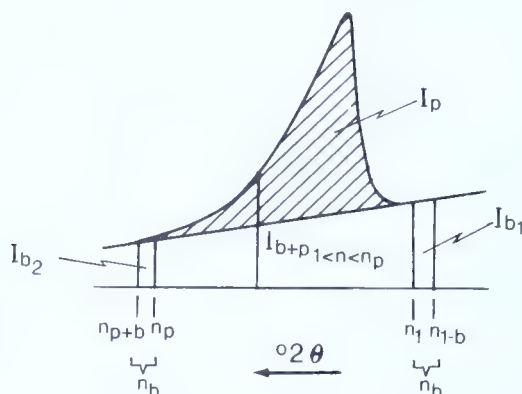
Correlation coefficients of peak area versus concentration were calculated from the standard mixtures. These correlation coefficients, as shown in Table 8, indicate good reliability for most peaks. The vermiculite peak was marginally reliable, but is the best known indicator. The montmorillonite peak area showed no correlation with concentration, even using the standard mixtures. This peak was, therefore, deleted from consideration and, unfortunately, no reliable indicator of montmorillonite concentration was found. Note that the reliability of all of the peaks would be reduced in measurement of natural samples.

The integrated intensities were obtained by step scanning across the peak, automatically measuring X-ray intensity at each step. Step scanning of the

Table 8. Correlation Coefficients of Diffraction Peak Area Versus Concentration Using Standard Mixtures

Mineral	hkl	Correlation coefficient
Quartz	100	0.9947
Mica	001	0.9069
Feldspar	002, +	0.9270
Calcite	104	0.9764
Kaolinite	$20\bar{2}, 1\bar{3}1, 11\bar{3}$	0.9615
Vermiculite	0·0·10	0.7900
Montmorillonite	007	-0.1166
Chlorite	005, 024	0.9692

selected peaks was controlled by a Philips 3181 Angle Mode Programmer. The counts, obtained with a Philips 3000 Series Data Measuring System, were fed directly into an Olivetti P602 microcomputer that calculated the integrated intensity using a revised version of Philips Electronic Instruments programs 6/QXD/OFL/3 and 6/QXD/ONL/4. The formula by which the intensity was calculated can be expressed as follows:



$$I_p = \sum_{n_1}^{n_p} \left(I_{b+p_n} - \frac{\sum_{n_1-b}^{n_1} I_{b1_n} + \sum_{n_p+b}^{n_p} I_{b2_n}}{2n_b} \right)$$

where I_p = integrated intensity of peak

n_p = number of steps required to traverse peak

I_{b+p_n} = intensity of background + peak counted at each step n

n_b = number of steps counted as background on each side of peak

I_{b1_n} = intensity of background counted at each step n on low 2θ side of peak

I_{b2_n} = intensity of background counted at each step n on high 2θ side of peak

A counting time of 0.2 second/step and a step increment of $0.02^\circ 2\theta$ yielded the best combination of efficiency and accuracy. The 2θ range selected for each peak is indicated in Table 7. In each case the first five steps ($0.1^\circ 2\theta$) and the last five steps were counted as background.

Each of the 16 standard mixtures listed in Table 6 was run three times. These results were used to plot calibration curves for each mineral. The contributions of kaolinite, chlorite, vermiculite, and montmorillonite to the 7Å and 14Å peaks were determined, and separate calibration curves for each of these minerals using these peaks were calculated.

Interference between mica and montmorillonite presented the most serious problem. Montmorillonite has the ability to expand and collapse as its moisture content varies. Consequently, its 001 spacing can vary from about 9.9Å, which coincides with mica, to 14Å, which coincides with chlorite and vermiculite. Most of the montmorillonite encountered in this study is in a partially hydrated form having a spacing of 10 to 11Å, which is observed in careful scans as a broad, asymmetric "tail" on the low- 2θ side of the mica 001 peak. Tests of the expandability of this material in several samples, using ethylene glycol, were positive and confirmed its identification as a montmorillonite or a montmorillonite-bearing interlayered material. The presence of this partially hydrated montmorillonite influenced the observed mica intensity in two ways: (1) completely dehydrated montmorillonite was indistinguishable from mica and yielded an enhanced mica intensity; (2) partially hydrated montmorillonite interfered with the low- 2θ background count for mica, yielding an artificially low mica intensity. Because of the presence of some montmorillonite in most samples, coupled with the variability in intensity and position of the montmorillonite peak, the mica calibration curve proved unusable. The use of other basal mica reflections was impossible because of interferences from other minerals. Other mica hkl reflections either have interferences with other common minerals, or are extremely weak and vary with mica composition.

Therefore, it was decided to determine mica (actually mica plus collapsed montmorillonite) by subtraction after all of the other mineral components had been determined. This procedure was chosen because: (1) no method was known to quickly and reliably determine mica concentration directly; (2) the calibration curves for the other minerals appeared to be reasonably reliable (see Table 8); and (3) complete X-ray scans of numerous samples revealed only minor amounts of minerals not included in this program. For each sample, the mica calibration curve was checked for approximate agreement. Whenever a major discrepancy was noted, the sample was subjected to a complete X-ray scan to check for additional, unanticipated components. The most common result of these scans was the detection of a relatively large amount of partially hydrated montmorillonite that had interfered with the background count for mica more than usual, thus substantially decreasing the measured intensity for mica.

PROCEDURES

After sample preparation and the measurement of integrated intensities, the following procedure was followed to determine the quantities of minerals in each sample:

1. Determine percent quartz from curve.
2. Determine percent calcite from curve.
3. Determine percent feldspar from curve.
4. Determine percent kaolinite from curve using the composite $20\bar{2}$, $1\bar{3}1$, $11\bar{3}$ peak at 2.34\AA .
5. Determine kaolinite contribution to 7\AA peak and subtract from total 7\AA intensity.
6. Determine percent vermiculite from curve using $0\cdot0\cdot10$ peak at 2.87\AA .
7. Determine vermiculite contribution to 7\AA peak and 14\AA peak and subtract.
8. Determine percent chlorite from curve using $005,024$ peak at 2.83\AA .
9. Determine chlorite contribution to 7\AA peak and 14\AA peak and subtract.
10. If all 7\AA intensity has been accounted for but some 14\AA remains, assume that the latter represents hydrated montmorillonite.
11. Make minor adjustments ($\pm 5\%$ or less) to the percentages of kaolinite, chlorite, and vermiculite to account for the observed 7\AA and 14\AA intensities, which are more sensitive indicators of concentration than the less intense peaks previously measured (steps 4, 6, and 8).
12. Carefully examine the X-ray chart for interferences, appropriate peak heights, and very broad 10\AA or 14\AA peaks that could be caused by montmorillonite.
13. Subtract the total of all minerals observed from 100% , and designate the remainder mica (or illite) plus dehydrated montmorillonite, reported in the individual sample data as "Mica."
14. Compare the mica percentage with the mica calibration curve and, progressively, with the results of other samples, to ascertain that there is at least approximate agreement. If not, or if interferences were observed in step 12, subject the sample to a complete X-ray scan. Make semiquantitative estimates of the concentration of minerals encountered that are not a part of this program, e.g., gypsum and pyrite.

The material listed as "Montmorillonite" for each sample represents only the amount that could be detected at 14\AA . Montmorillonite that causes diffraction at about 10\AA could not be distinguished from mica in this rapid procedure. This, plus the method of determining the 14\AA montmorillonite (by assuming remaining 14\AA intensity to be caused by this mineral), prob-

ably yield considerable error in the values reported for this mineral. Because of the probable presence of the partially dehydrated montmorillonite in most of the samples, the reported montmorillonite values can best be interpreted as minimum values. Likewise, the reported mica values should be interpreted as maximum values that probably include some collapsed montmorillonite.

ACCURACY AND PRECISION

Absolute tests of accuracy were not possible because compatible standard shale samples for which the mineral concentrations are accurately known are not available. Tests were made, however, to compare the results of this procedure with those obtained using the procedure formulated by Lapham, Jaron, and Saylor (O'Neill and others, 1965; Hoover and others, 1971).

Five samples originally studied by Hoover and others were tested using the new procedure and the results were compared (Table 9). This comparison shows a general agreement. The differences between the two are not surprising considering the compromises and assumptions required by both methods. The differences could also reflect variations in preferred orientation and inhomogeneity of the samples.

Perhaps more interesting is a comparison of the chemical analyses of these samples, reported by Hoover and others, with the chemistry as calculated from the two mineralogical determinations (assuming stoichiometry and the chlorite: vermiculite: montmorillonite ratio of 4:2:1 assumed by Lapham in Hoover and others, 1971) (Table 10). The results show better agreement between the two calculations from the X-ray diffraction studies than between either of them and the chemical analyses. Because the chemical analyses are probably more accurate, this could be as likely caused by deviations from stoichiometry that are common in clay minerals as by similar errors in the two X-ray methods.

As a test of precision, at the start of the project two samples were run 10 times, and a new sample holder was packed each time. Each of these samples was also run in its normal turn in the course of the project. The low precision indicated in Table 11 is probably caused by two factors: (1) preferred orientation, and (2) variations in packing the sample holder. For calcite, chlorite, vermiculite, montmorillonite, and feldspar the exceedingly large standard deviations are probably also a result of a poor signal-to-noise ratio in measurement of peaks of very low intensity. These values should improve if greater concentrations are present. Comparison with the results reported by Hoover and others (1971) is not unfavorable; large potential errors also were reported in that study (see Table 9, this study).

The data presented in this report provide an estimate of the mineral content of the samples. Reported differences between samples of less than 5 percent of the major constituents (quartz, mica, kaolinite) or less than 2

Table 9. Comparison of Quantitative X-ray Diffraction Results Using Procedures of Hoover and Others (1971) (M 63) and Those of This Study

Mineral	Sample: 167-1-5		168-8-12		147-9-3		109-6-5		139-1-5B	
	M 63	This study	M 63	This study	M 63	This study	M 63	This study	M 63	This study
Quartz	30 ± 5	27	22 ± 6	10	20 ± 5	23	30 ± 8	28	14 ± 7	8
Mica	49 ± 6	64	71 ± 7	82	45 ± 6	51	56 ± 10	60	54 ± 6	65
Kaolinite	5 ± 3	0	0	0	10 ± 8	5	0	0	11 ± 5	5
Chlorite		2		2		13		4		2
Vermiculite		0		0		2		0		0
Montmorillonite		0		0		2		0		5
C-V-Mo *	9 ± 3	(2)	0	(2)	13 ± 3	(17)	7 ± 3	(4)	8 ± 3	(7)
Feldspar	2 ± 1	7	2 ± 1	5	2 ± 1	4	2 ± 1	8	9 ± 2	14
Calcite	--	0	--	1	--	0	--	0	--	1

*Undifferentiated chlorite, vermiculite, and montmorillonite at assumed ratio of 4:2:1. Numbers in parentheses are total chlorite, vermiculite, and montmorillonite determined individually.

Table 10. Comparison of Chemical Analyses and Chemistry Calculated from Two Quantitative X-ray Diffraction Procedures

Oxide	Sample: 167-1-5			168-8-12			147-9-3			109-6-5			139-1-5B		
	Anal. *	Calc. M 63†	Calc. M 77‡	Anal.	Calc. M 63	Calc. M 77	Anal.	Calc. M 63	Calc. M 77	Anal.	Calc. M 63	Calc. M 77	Anal.	Calc. M 63	Calc. M 77
SiO ₂	66.60	70.04	71.68	54.84	70.46	64.36	54.18	64.05	65.12	61.30	71.47	71.55	48.18	63.44	60.47
Al ₂ O ₃	12.50	15.82	16.46	22.22	17.70	20.23	24.73	18.52	17.49	17.48	15.13	16.03	17.70	20.61	19.67
Fe ₂ O ₃	6.42	0.53	0.11	4.56		0.11	4.91	0.80	1.03	4.61	0.41	0.22	5.89	0.46	5.24
FeO	0.45	0.19	0.04	2.52		0.04	3.10	0.28	0.25	2.63	0.15	0.08	1.44	0.17	0.04
CaO	1.80			0.06		0.57	0.20	0.05	0.05	1.21			4.46		0.66

MgO	1.88	3.14	0.66	2.05	0.66	1.73	4.79	4.61	3.05	2.43	1.32	3.51	2.75	1.15
CO ₂	1.91			0.00	0.44	0.23			0.20			4.36		0.42
Na ₂ O	0.71	0.25	0.83	0.07	0.25	0.81	0.27	0.49	1.00	0.25	0.95	3.24	1.11	1.63
K ₂ O	3.50	4.85	6.00	8.34	7.01	2.83	4.70	4.88	2.54	5.53	5.63	3.73	5.29	5.79
TiO ₂	0.86			0.81		0.92			0.91			0.90		
H ₂ O	NA	5.18	4.19	3.78	4.58	5.78	6.60	6.08	4.34	4.62	4.22	4.24	6.18	4.93

*Chemical analyses reported by Hoover and others (1971).

†Chemistry calculated from mineralogy determined by method of Lapham, Jaron, and Saylor (Hoover and others, 1971).

‡Chemistry calculated from mineralogy determined by method of this report.

Table 11. Ten Replicate X-ray Determinations of Two Samples Given as an Indication of Precision

	46-C-2A				4-C-3B			
	Mean	Std. dev.	8/18/76*		Mean	Std. dev.	12/3/76*	
Quartz	19.2%	2.04	17%		41.5%	3.98	35%	
Calcite	0.0	-	0		0.3	0.46	0	
Mica	48.5	4.06	45		28.3	5.39	37	
Feldspar	3.6	1.80	2		0.6	0.92	3	
Kaolinite	26.2	4.21	32		27.9	4.93	25	
Vermiculite	0.7	1.42	0		0.5	1.20	0	
Chlorite	1.4	1.36	0		0.4	0.92	0	
Montmorillonite	0.4	0.66	4		0.5	1.20	0	

*Rerun of sample in normal sequence in project.

percent of other constituents are probably not significant. Fortunately, differences of such magnitude are probably not significant in the evaluation of the use potential of a raw material, inasmuch as most uses appear to tolerate a rather broad mineralogical range. Therefore, these data can probably be used to obtain a generalized picture of mineralogy versus potential use and of general trends in mineral variation in Pennsylvania shales and clays.

ADDITIONAL STUDIES

After completion of the above procedure, 11 samples were randomly selected for additional X-ray diffraction study. These samples were prepared by a sedimentation procedure as oriented aggregates on glass microscope slides. Three such slides were prepared for each sample. One was subjected to an X-ray scan directly. A second was placed in an atmosphere containing ethylene glycol for a minimum of 24 hours, then scanned. A third was heated to 535°C for one hour, then scanned. The samples tested were 4-C-3B, 5-A-22, 5-C-15, 6-B-5, 19-D-4A, 29-B-6, 46-C-2A, 48-C-4, 49-C-3E, 69-D-5, and 140-A-1B.

The results of these more extensive qualitative tests are in general agreement with the more rapid quantitative tests. A minor problem in the distinction of chlorite and kaolinite in the rapid method did appear. The main problem with the quantitative procedure that was illustrated by these tests is that of the interference between montmorillonite and mica, discussed previously.

Forty-seven samples were also subjected to combined differential thermal analysis (DTA) and thermogravimetric analysis (TGA). These results are in general agreement with those obtained by the quantitative X-ray method. However, the DTA-TGA method resolved kaolinite from chlorite and confirmed the minor problem in their distinction via rapid X-ray diffraction methods.

CHEMICAL ANALYSES

GENERAL STATEMENT

A 100-gram split of each sample that was sent to the U. S. Bureau of Mines in Tuscaloosa, Alabama, for physical and firing tests was crushed to minus 200 mesh and returned to the Pennsylvania Bureau of Topographic and Geologic Survey for analysis for major and minor elements. The analyses were carried out in one of two laboratories using different methodology. The 160 samples from the Greater Pittsburgh Region, constituting all of the samples from Allegheny, Armstrong, Beaver, Butler, and Washington Counties, and most of the samples from Westmoreland County, were analyzed by the U. S. Geological Survey. The remaining 253 samples from southwestern Pennsylvania were analyzed by the Pennsylvania Bureau of Topographic and Geologic Survey. The results of all analyses

are included with the individual sample data and in Table 12. Those done by the U. S. Geological Survey are identified by an asterisk before the sample number.

The method used by the U. S. Geological Survey was that described by Shapiro and Brannock (1962), later modified by Shapiro (1967), employing fusion of the sample in LiBO_2 followed by spectrophotometric and atomic absorption measurements.

The analyses of the remaining 253 samples by the Pennsylvania Bureau of Topographic and Geologic Survey were partial in scope, consisting of nine elements expressed as the oxides SiO_2 , TiO_2 , Al_2O_3 , total Fe as Fe_2O_3 , MnO, MgO, CaO, Na_2O , and K_2O . The Na_2O and K_2O were analyzed by flame emission using the Perkin-Elmer Model 305A atomic absorption apparatus. The other seven elements were analyzed using the same apparatus in the absorption mode.

PROCEDURES

The method of sample preparation was based on that described by Medlin and others (1969) with some minor modifications suggested by N. H. Suhr (personal communication, 1976). All glassware and plasticware were cleaned in chromic acid. Splits of the powdered sample were heated to 115°C for one hour and stored in a desiccator. A 0.2000-g aliquot of each minus-200-mesh sample was thoroughly mixed with 0.8000 g of dried LiBO_2 using an agate mortar and pestle for approximately 10 to 12 minutes. After mixing, the material was transferred to a pre-ignited graphite crucible. The mixture was fused in a muffle furnace at 1000°C for 12 minutes, then transferred, while still molten, into 40 ml of 4% HNO_3 in a polypropylene beaker. This stock solution was stirred gently in the covered beaker using a magnetic stirrer for one-half hour, after which it was transferred to a Nalge polypropylene 125-ml bottle.

Two dilutions were made from the stock solution. One was prepared by mixing 4 ml of stock solution with 40 ml of the La solution "A" described by Medlin and others (1969). This La dilution was used for the determination of all but Na_2O and K_2O . The dilution used for Na_2O and K_2O was prepared by mixing 1 ml of stock solution with 60 ml of distilled and deionized water.

A list of the materials used as standards for each element is presented in Table 13. All of these reference samples have been repeatedly analyzed by many laboratories, and their contents are well documented. The values assumed for these analyses are, in most cases, the average of the values reported by Flanagan (1970) and Abbey (1972). The blank that was used in the analysis of some elements was prepared in the same manner as the other samples except for the omission of sample material.

Two synthetic "shale" standards, "Pennsylvania Average Shale" and "Earth Average Shale," were prepared from reagent-grade chemicals. The

Table 12. Chemical Analyses of Shale and Clay Samples

County	Sample number	Volatiles (percent)																
		SiO ₂	FeO	Al ₂ O ₃	Fe ₂ O ₃	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	% (total)	(comp)	CO	H ₂ O	H ₂ O +		
Allegheny	* 6 D 16	63.5	1.0	18.9	4.1	0.76	1.0	0.44	0.20	2.8	0.27	0.05	0.52	0.07	1.9	4.3	1.4	
	* 6 D 17	44.7	0.54	15.8	1.7	1.2	1.2	13.4	0.18	1.9	0.62	0.38	1.1	10.3	1.3	5.9	0.10	
	* 16 C 1	56.6	0.98	20.0	4.8	1.4	1.8	1.3	0.13	3.8	0.16	0.06	0.38	0.08	2.0	5.6	0.60	
	* 16 C 8	84.9	1.0	18.7	2.4	4.0	0.03	1.2	0.52	2.8	0.12	1.1	2.9	0.04	2.2	8.1	3.1	
	* 16 C 9	87.3	0.93	18.1	2.9	2.2	0.04	1.9	3.0	0.15	0.12	1.3	0.76	0.05	1.9	5.3	2.0	
	* 16 C 10	86.3	1.0	18.6	4.0	4.0	0.13	2.3	0.79	0.77	0.17	0.24	1.6	0.45	0.89	5.8	0.80	
	* 17 B 2A	87.0	1.0	19.6	4.3	3.2	0.07	1.9	0.62	0.12	0.26	0.45	1.1	0.07	1.2	6.0		
	* 17 B 2B	87.9	0.89	19.6	4.4	3.4	0.09	1.9	0.42	0.28	0.2	0.16	1.0	0.03	0.86	5.7		
	* 17 B 3A	87.5	1.0	20.8	4.5	2.8	0.02	1.7	0.33	0.26	0.1	0.09	0.04	0.17	0.02	1.7	6.0	
	* 17 B 3B	88.9	0.88	19.7	4.8	3.9	0.19	2.1	0.70	0.66	0.1	0.22	0.09	0.17	0.07	1.1	6.0	
	* 27 C 9	81.7	0.88	21.4	10.2	0.8	0.07	1.4	0.35	0.36	1.4	0.24	0.11	0.54	0.02	2.0	7.2	
	* 27 C 10A	86.0	0.84	20.3	2.8	5.3	0.05	2.3	0.51	0.65	2.9	0.22	0.06	0.82	0.67	1.0	6.5	
	* 27 C 10B	88.7	0.93	19.0	2.2	5.6	0.14	2.2	0.37	0.77	2.9	0.17	0.06	0.44	0.05	0.7	5.7	
	* 27 C 10C	86.3	0.91	19.7	8.2	2.9	0.11	2.4	0.68	0.87	3.2	0.17	0.04	0.16	0.05	1.6	6.2	
	* 27 C 11A	81.8	0.84	22.9	2.1	5.5	0.10	1.8	0.60	0.37	3.3	0.16	0.28	1.1	1.8	1.3	6.8	
	* 27 C 11B	86.5	1.0	20.0	2.5	4.9	0.12	2.2	0.50	0.72	3.4	0.12	0.06	0.49	1.5	0.63	6.0	
Armstrong	* 27 C 11C	80.1	0.81	17.4	3.4	3.1	0.16	3.0	4.2	0.22	3.4	0.21	0.86	0.23	5.3	2.2	5.9	
	* 27 C 11D	83.1	0.86	20.1	7.6	0.88	0.04	1.9	0.65	0.48	4.6	0.25	0.07	0.69	0.12	2.8	6.7	
	* 28 A 4A	66.2	1.0	14.6	2.0	4.0	0.10	2.1	1.2	1.2	0.16	0.40	0.10	0.95	0.55	4.2		
	* 28 A 4B	88.7	0.82	12.4	2.1	4.6	0.22	1.8	6.5	1.1	0.15	0.30	0.10	0.9	0.38	1.9		
	* 28 A 4C	60.6	0.94	16.1	1.4	5.6	0.13	2.1	1.4	1.0	0.20	0.17	0.1	2.2	0.52	4.6		
	* 28 A 4D	51.4	0.70	12.6	0.24	13.8	0.55	2.1	1.9	0.33	0.26	0.17	0.12	9.1	0.42	4.1		
	* 28 A 4E	87.1	0.94	18.4	1.6	6.2	0.23	1.3	0.45	0.43	0.16	0.09	1.2	2.0	0.73	6.2		
	* 28 A 4G	46.6	0.78	17.8	2.8	9.6	0.51	2.3	2.7	0.36	0.48	0.02	0.1	6.1	0.70	5.4		
	* 28 A 4H	87.9	1.0	20.0	2.2	5.3	0.11	2.4	0.24	0.85	3.8	0.12	0.13	0.32	0.06	0.56	5.4	
	* 28 A 4I	88.6	0.91	26.5	3.4	5.0	0.08	2.3	0.46	0.24	4.2	0.15	0.10	0.41	0.02	0.79	6.1	
	* 28 A 4J	55.3	0.96	16.9	2.3	6.2	0.16	2.3	3.1	0.57	2.5	0.12	0.00	0.1	3.7	0.42	5.4	
	* 28 A 4K	51.7	0.82	14.9	1.8	6.7	0.27	2.0	5.8	0.35	2.2	0.17	0.02	0.19	7.2	0.57	4.8	
	* 28 A 4L	51.1	0.86	21.4	2.7	4.9	0.08	2.4	1.5	0.30	4.3	0.21	0.90	0.95	2.1	0.88	7.1	
	* 35 B 5	87.7	1.1	23.9	1.5	1.4	0.00	1.1	0.23	0.21	3.0	0.05	0.36	0.66	0.07	1.2	7.7	0.00
	* 35 B 6	89.5	0.79	17.2	3.4	3.0	0.04	1.7	0.66	0.28	3.4	0.36	1.9	1.8	0.28	1.2	5.6	1.7
	* 35 C 3A	60.0	1.6	24.0	1.2	0.56	0.00	0.64	0.19	0.21	2.6	0.05	0.02	0.18	0.02	0.90	7.4	0.18
* 35 C 3B	66.7	0.98	16.6	2.2	3.0	0.04	0.66	0.16	0.19	2.2	0.05	0.01	0.22	1.2	0.47	4.7	0.40	
* 35 C 3C	86.6	1.3	23.8	1.3	2.6	0.00	0.88	0.25	0.23	2.5	0.12	0.01	0.58	0.50	1.1	7.8	0.00	
* 35 C 3D	86.8	0.91	20.7	4.2	2.2	0.01	1.4	0.39	0.26	3.3	0.12	0.32	1.5	0.01	0.97	6.7	1.7	

Beaver

Not reported

*35-C-4A	55.7	0.88	20.0	5.7	2.0	0.11	1.4	0.21	0.22	3.0	0.14	0.50	2.4	0.01	0.87	6.0	3.4
*35-C-4B	52.2	0.93	22.0	3.3	3.8	0.17	1.9	0.46	0.18	3.3	0.26	1.4	1.6	0.70	0.98	7.3	1.6
*35-D-2A	55.4	0.90	20.3	1.9	5.1	0.08	1.8	0.47	0.23	3.0	0.12	0.42	1.2	2.0	0.64	5.8	1.0
*35-D-2B	61.6	1.0	20.0	1.5	3.3	0.01	1.8	0.42	0.24	2.9	0.11	0.04	0.32	0.48	0.68	5.3	0.42
*35-D-7	58.7	0.88	18.7	1.5	4.4	0.05	1.8	0.98	0.33	2.8	0.13	0.16	0.12	2.3	1.0	5.1	0.00
*45-B-1	60.5	0.85	19.3	3.7	2.1	0.05	1.8	0.31	0.14	3.3	0.15	0.43	0.26	0.03	0.92	5.6	0.00
*45-B-2A	56.2	1.1	22.6	1.9	1.5	0.00	0.94	0.63	0.18	2.5	0.21	0.92	2.0	0.03	1.4	7.7	2.2
*45-B-2B	56.0	1.0	20.0	1.9	4.9	0.02	1.6	0.98	0.23	3.4	0.24	0.07	0.60	2.6	0.76	5.3	0.00
*45-B-3	60.5	0.90	18.9	2.5	3.5	0.04	1.9	0.47	0.14	3.2	0.16	0.13	0.53	0.60	0.81	5.1	0.15
*45-B-4A	50.2	0.81	21.7	3.1	5.3	0.24	2.1	0.48	0.22	3.7	0.23	1.2	1.3	1.5	0.96	6.1	2.0
*45-B-4B	55.2	0.93	19.9	3.1	4.0	0.06	1.8	0.41	0.25	3.3	0.24	1.3	1.9	0.28	0.79	6.5	2.0
*46-A-1A	50.9	0.79	17.6	2.7	4.6	0.06	1.9	0.93	0.15	2.8	0.28	2.2	7.0	1.6	1.0	6.8	6.3
*46-A-1B	54.9	0.94	19.9	1.7	3.7	0.03	2.4	2.6	0.21	2.9	0.13	0.09	0.10	3.0	0.77	5.6	0.15
*46-C-2A	54.0	0.92	19.8	1.6	6.6	0.12	1.5	0.50	0.31	3.0	0.14	0.13	1.2	0.73	5.1	2.4	
*46-C-2B	53.6	0.91	21.8	1.5	5.2	0.06	1.7	0.40	0.29	3.4	0.14	0.28	2.0	0.87	5.9	1.0	
*06-B-1	60.0	1.3	20.6	1.4	0.8	0.0	0.7	0.21	0.2	2.0	0.17	0.25	4.5	0.7	1.3	7.4	3.9
*5-C-15	62.4	1.2	19.2	1.8	2.5	0.03	1.4	0.29	0.31	3.0	0.11	0.40	1.1	0.06	0.89	6.0	0.34
*5-C-16	55.8	0.9	23.0	1.7	3.6	0.03	1.8	0.46	0.60	4.1	0.24	0.1	0.67	0.06	1.0	6.5	0.0
*5-C-17	54.6	1.2	25.0	3.1	0.68	0.02	0.87	0.29	0.32	2.7	0.16	1.6	0.50	0.02	1.1	7.8	1.6
*5-C-18	52.9	1.0	21.0	1.2	5.4	0.10	1.6	0.44	0.36	3.2	0.17	0.35	4.0	1.7	1.1	6.3	3.3
*5-C-19	52.7	0.85	21.1	7.1	2.1	0.06	1.8	0.46	0.36	3.7	0.34	1.2	1.0	0.03	1.2	6.6	1.4
*5-C-26	62.1	1.9	22.3	1.3	0.36	0.01	0.52	0.38	0.11	1.3	0.13	0.43	0.32	0.06	1.4	7.2	0.30
*5-C-27	51.9	0.91	22.4	3.0	4.7	0.20	2.0	0.54	0.24	3.6	0.29	1.1	0.87	0.04	0.92	6.8	1.5
*5-C-28	58.6	1.4	23.4	1.5	1.3	0.03	1.2	0.33	0.24	2.8	0.10	0.25	0.78	0.08	2.3	5.8	0.60
*5-C-29	55.2	1.7	25.4	2.1	5.6	0.01	0.50	0.24	0.15	1.4	0.18	0.4	0.52	0.08	2.0	8.8	1.0
*5-C-30	53.3	1.4	24.4	3.2	0.80	0.0	0.84	0.20	0.22	2.6	0.23	1.3	1.9	0.08	1.5	8.5	2.0
*5-D-6	61.1	0.94	17.0	6.9	1.0	0.12	1.4	0.23	0.17	3.1	0.20	0.08	0.73	0.08	1.1	5.7	0.60
*5-D-7	55.2	0.88	21.0	4.8	2.8	0.12	2.0	0.3	0.36	3.4	0.26	0.36	1.3	0.08	0.9	6.3	0.8
*5-D-8	57.5	0.96	19.8	6.3	1.6	0.11	1.9	0.37	0.36	3.2	0.21	0.05	0.65	0.07	1.0	5.8	0.3
*5-D-9	66.0	1.5	20.8	1.0	0.6	0.0	0.57	0.15	0.26	2.2	0.03	0.17	0.44	0.0	0.54	6.1	0.0
*5-D-10	60.5	0.96	16.5	5.5	3.6	0.10	1.9	0.78	0.68	2.6	0.22	0.05	1.2	1.0	0.96	4.7	0.0
*5-D-11	60.1	1.0	18.0	2.2	4.4	0.16	1.8	0.73	0.44	2.6	0.11	0.23	0.32	2.0	1.1	5.4	0.0
*5-D-12	55.8	0.97	20.6	4.7	2.4	0.1	1.9	0.32	0.6	3.2	0.29	0.3	1.3	0.08	1.3	6.4	1.0
*5-D-13	55.8	0.92	20.0	5.4	2.1	0.15	2.0	0.54	0.62	3.6	0.22	0.13	0.99	0.08	1.2	6.0	1.0
*5-D-14	45.5	0.97	23.2	2.7	1.2	0.03	1.4	0.43	0.24	2.9	0.31	0.11	12.5	0.05	1.3	9.4	-
*6-A-7	60.0	0.96	18.8	4.5	2.4	0.05	1.9	0.39	0.63	3.0	0.19	0.22	1.3	0.08	0.84	5.4	0.0
*6-A-8	47.9	1.0	21.9	2.6	1.2	0.01	1.0	1.0	0.21	2.8	0.11	1.1	8.8	0.08	1.5	7.9	9.8
*6-B-1	61.8	1.1	17.0	2.1	4.4	0.10	1.5	0.40	0.20	2.6	0.18	0.08	0.95	1.3	0.58	5.9	0.0
*6-B-2	60.2	1.1	18.5	5.1	2.8	0.10	1.9	0.50	0.45	2.8	0.19	0.07	1.1	0.23	0.61	5.5	0.0
*6-B-3	65.9	1.5	19.3	1.4	1.3	0.01	0.74	0.26	0.27	2.0	0.06	0.34	0.30	0.08	0.57	5.8	
*6-B-4	64.4	1.2	19.9	2.3	0.48	0.01	0.85	0.30	0.41	2.7	0.09	0.52	0.32	0.08	0.70	5.6	1.0

Table 12. (Continued)

County	Sample number	SiO ₂	TiO ₂	Al ₂ O ₃	Fe ₂ O ₃	FeO	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	S (total)	C (org.)	CO ₂	H ₂ O ⁺	H ₂ O ⁻	Volatiles (except H ₂ O, CO ₂)
Beaver	*6-B-5	46.4	1.4	24.1	5.3	0.76	0.01	0.66	0.55	0.62	1.9	0.20	2.0	1.5	0.02	2.4	10.5	5.0
	*6-B-6	72.1	1.3	15.6	1.9	0.28	0.00	0.42	0.24	0.55	1.5	0.04	0.27	0.21	0.03	0.70	4.9	0.3
	*6-B-9	62.2	1.0	18.5	3.7	2.0	0.03	1.4	0.33	0.55	2.7	0.07	0.74	0.50	0.03	0.87	5.1	0.7
	*6-B-10	58.5	0.91	16.8	3.1	2.6	0.07	1.7	3.2	0.63	2.7	0.14	1.3	0.86	3.1	1.1	4.7	0.0
	*6-B-18	55.5	0.96	20.4	2.1	5.0	0.06	1.8	0.94	0.22	3.4	0.18	0.10	0.36	2.1	1.0	5.6	0.0
	*6 B 19	56.0	1.0	22.3	2.4	3.4	0.04	1.8	0.46	0.22	3.5	0.10	0.10	0.80	0.95	0.90	6.3	0.0
	*6-B-20	43.9	0.88	16.7	1.3	13.6	0.27	1.8	2.3	0.13	2.5	0.29	0.14	0.21	9.5	1.3	4.6	-
	*6-C-12	53.3	1.1	22.3	5.2	2.2	0.07	0.83	0.40	0.20	2.5	0.38	0.63	0.74	1.1	1.6	7.2	1.2
	*6-C-13	59.8	1.0	18.9	1.9	4.2	0.10	1.7	0.70	0.25	3.1	0.25	0.29	0.24	0.08	0.48	5.2	1.5
	*6-C-14	63.4	1.0	16.8	6.8	0.64	0.07	0.82	0.26	0.22	2.4	0.14	0.25	0.32	0.07	1.4	5.4	-
	*6-C-15	61.0	0.94	18.5	4.5	0.60	0.01	1.1	0.36	0.31	2.6	0.19	0.46	1.3	0.02	2.1	5.9	1.7
	*6-D-11	55.5	0.97	18.8	6.4	0.40	0.32	1.6	2.1	0.30	3.3	0.56	0.03	0.47	0.08	2.6	5.5	0.80
	*6-D-21	56.0	0.96	21.2	4.4	2.5	0.04	2.0	0.36	0.64	3.3	0.19	0.10	0.23	0.02	1.3	6.1	0.0
	*6-D-22	54.7	0.97	19.5	4.5	3.9	0.16	2.5	1.1	0.80	2.8	0.16	0.10	0.52	1.0	0.79	6.2	0.0
	*6-D-23	57.0	1.1	22.0	2.9	0.48	0.03	1.2	1.4	0.13	2.9	0.05	0.05	0.61	0.08	2.6	6.5	1.0
	*6-D-24	61.4	1.0	20.0	4.4	0.80	0.03	0.83	0.33	0.25	2.1	0.07	0.03	0.16	0.04	1.8	6.1	0.0
	*6-D-25	58.7	1.0	19.3	6.0	0.40	0.03	1.3	0.72	0.12	2.4	0.13	0.02	0.15	0.02	3.4	5.9	0.0
	*15-C-5	57.0	1.0	18.7	2.2	5.8	0.09	2.0	0.37	0.60	3.0	0.19	0.21	1.9	0.08	0.56	5.6	2.0
	*15-C-6	64.7	1.1	18.5	4.6	0.36	0.09	0.64	0.07	0.21	2.4	0.10	0.10	0.25	0.02	0.92	5.6	0.0
	*15-C-7	55.0	0.92	20.2	6.8	1.6	0.22	1.7	0.30	0.42	3.2	0.31	0.52	1.0	0.01	1.1	6.3	1.2
Butler	*15-A-8A	57.2	0.86	19.5	1.8	5.0	0.05	2.2	0.63	0.47	3.3	0.26	0.34	1.6	0.82	0.46	5.3	1.2
	*15-A-8B	60.8	0.98	17.8	0.5	5.0	0.08	1.9	0.9	0.8	2.7	0.16	0.15	0.84	1.5	0.34	4.5	0.96
	*15-D-9	58.8	1.2	21.4	2.2	1.3	0.0	1.3	0.33	0.26	3.1	0.05	0.9	0.39	0.04	1.5	6.2	0.86
	*15-D-10	58.4	0.99	18.0	2.2	4.5	0.08	1.5	0.35	0.26	2.7	0.09	0.44	2.1	1.4	0.72	5.3	2.4
	*16-A-6	62.5	1.0	17.2	5.5	1.3	0.10	1.9	0.40	1.1	2.6	0.16	0.03	0.23	0.01	1.3	4.6	0.0
	*24-B-1A	64.7	1.7	19.0	0.97	0.84	0.01	0.64	0.18	0.22	2.7	0.05	0.45	1.1	0.07	0.73	5.2	1.5
	*24-B-1B	59.0	0.92	19.2	2.4	3.4	0.03	1.9	0.44	0.23	3.5	0.20	0.26	1.0	0.38	0.63	5.4	0.97
	*24-B-4A	67.2	1.3	19.0	0.92	0.52	0.00	0.64	0.16	0.19	2.6	0.05	0.04	0.08	0.03	0.51	5.4	0.43
	*24-B-4B	65.7	2.0	17.1	4.2	0.16	0.00	0.61	0.27	0.22	2.7	0.12	0.01	0.77	0.04	1.1	4.9	0.40
	*24-C-2A	56.8	1.2	24.6	2.1	0.80	0.0	1.0	0.17	0.20	3.1	0.05	0.02	0.75	0.06	1.2	7.3	0.62
	*24-C-2B	54.1	0.89	20.6	5.6	2.6	0.03	1.5	0.15	0.20	3.6	0.15	0.10	1.8	0.35	0.96	8.8	0.0
	*24-C-3	56.6	0.94	17.6	2.8	4.6	0.09	1.6	0.45	0.20	3.1	0.17	0.66	3.2	1.3	0.78	5.0	3.4
	*34-A-10A	70.9	1.5	15.1	1.8	0.40	0.0	0.51	0.12	0.13	1.8	0.04	0.73	0.35	0.08	0.68	4.6	0.87
	*34-A-10B	58.9	0.91	20.0	3.1	2.6	0.04	1.8	0.37	0.18	3.5	0.21	0.21	0.83	0.05	0.72	5.8	0.65
	*34-A-11A	52.4	0.83	20.5	3.6	3.7	0.12	2.0	1.1	0.19	3.5	0.19	2.1	0.83	1.6	1.1	6.8	1.2

Cambria	*34-A-11B	58.3	0.89	19.9	1.7	4.2	0.04	1.8	0.62	0.23	3.4	0.18	0.35	0.98	1.0	0.57	5.4	0.60
	*34-A-11C	73.7	1.3	14.5	0.97	0.48	0.00	0.44	0.13	0.16	2.0	0.03	0.38	1.0	0.04	0.42	3.8	1.1
	*34-A-12	53.9	0.83	21.0	2.3	5.4	0.07	2.2	0.32	0.18	4.0	0.14	0.44	0.95	0.02	0.92	5.9	1.3
	66-B-3	61.90	1.10	21.50	2.40†	-	0.033	0.97	0.40	0.19	3.20	-	-	-	-	-	-	-
	66-D-4	57.60	0.93	19.90	8.58†	-	0.048	2.02	0.30	0.65	3.23	-	-	-	-	-	-	-
	67-A-A-4A	59.40	1.00	21.45	6.32†	-	0.014	0.88	0.06	0.22	3.93	-	-	-	-	-	-	-
	67-A-4B	52.90	1.79	26.15	1.96†	-	0.014	0.87	0.05	0.25	3.04	-	-	-	-	-	-	-
	67-A-A-5A	59.70	1.09	20.90	4.18†	-	0.022	0.77	0.12	0.19	3.40	-	-	-	-	-	-	-
	67-A-5B	56.30	1.04	19.90	8.80†	-	0.141	1.78	0.35	0.22	3.39	-	-	-	-	-	-	-
	67-A-8	60.40	0.85	17.20	7.20†	-	0.101	1.61	0.85	0.47	4.48	-	-	-	-	-	-	-
	67-A-A-9A	61.70	1.03	18.10	6.26†	-	0.092	1.28	0.23	0.23	3.06	-	-	-	-	-	-	-
	67 A-9B	65.70	0.92	16.65	5.20†	-	0.062	1.22	0.15	0.22	2.78	-	-	-	-	-	-	-
	67-C-1	58.60	0.96	19.30	6.29†	-	0.088	1.51	0.25	0.22	3.37	-	-	-	-	-	-	-
	67 C-2	60.80	1.09	22.80	3.53†	-	0.014	1.08	0.41	0.19	3.92	-	-	-	-	-	-	-
	67-C-7	60.50	1.03	20.20	5.28†	-	0.054	1.67	0.25	0.22	3.67	-	-	-	-	-	-	-
	67-D-3A	56.20	0.98	17.25	7.50†	-	0.044	1.45	0.14	0.52	2.97	-	-	-	-	-	-	-
	67-D-3B	60.80	1.00	18.15	8.02†	-	0.153	1.71	0.30	0.38	3.55	-	-	-	-	-	-	-
	67-D-6	60.80	0.96	17.55	7.35†	-	0.114	1.46	0.25	0.20	3.22	-	-	-	-	-	-	-
	76-A-2A	64.70	1.12	20.05	1.78†	-	0.014	0.73	0.21	0.16	2.60	-	-	-	-	-	-	-
	76 A-2B	57.20	0.90	16.65	12.85†	-	0.148	1.06	0.45	0.14	2.60	-	-	-	-	-	-	-
	76-A-4	65.00	0.98	17.75	5.46†	-	0.046	1.02	0.07	0.20	3.29	-	-	-	-	-	-	-
	76 B-7	59.50	0.94	20.80	7.05†	-	0.065	1.90	0.24	0.59	3.40	-	-	-	-	-	-	-
	76-C-3	57.90	1.05	18.65	8.27†	-	0.077	1.86	0.31	0.23	3.63	-	-	-	-	-	-	-
	76 C-4	58.80	0.97	18.65	8.22†	-	0.074	1.84	0.45	0.32	3.31	-	-	-	-	-	-	-
	76-C-5	62.90	0.95	16.80	6.68†	-	0.093	1.57	0.23	0.98	2.62	-	-	-	-	-	-	-
	76-D-1	60.90	1.00	16.85	6.75†	-	0.096	1.50	0.16	0.22	2.75	-	-	-	-	-	-	-
	76-D-6	57.90	0.98	19.00	8.00†	-	0.196	1.86	0.40	0.88	3.32	-	-	-	-	-	-	-
	76-D-8	60.90	1.06	19.00	6.18†	-	0.072	1.66	0.14	0.23	3.23	-	-	-	-	-	-	-
	77-A-1	57.90	0.96	19.20	7.35†	-	0.094	2.02	0.26	0.86	3.35	-	-	-	-	-	-	-
	77 A-2	62.50	1.05	17.25	6.42†	-	0.06	1.72	0.30	0.90	2.81	-	-	-	-	-	-	-
	77 A-8	67.30	0.96	14.65	5.35†	-	0.064	1.12	0.39	0.34	2.48	-	-	-	-	-	-	-
	77-B-7	62.50	1.05	18.10	6.57†	-	0.046	1.37	0.12	0.20	3.03	-	-	-	-	-	-	-
	77-C-3	57.80	1.03	18.75	7.74†	-	0.068	2.32	0.41	0.92	3.13	-	-	-	-	-	-	-
	77-C-4	64.40	1.03	16.80	4.76†	-	0.072	1.17	0.11	0.16	2.66	-	-	-	-	-	-	-
	77 C-5	64.30	1.27	19.80	1.56†	-	0.009	0.77	0.00	0.14	2.91	-	-	-	-	-	-	-
	77 C-6A	56.40	1.35	22.55	4.55†	-	0.04	0.64	0.15	0.18	2.44	-	-	-	-	-	-	-
	77-C-6B	62.30	0.89	16.55	7.10†	-	0.119	1.35	0.34	0.15	2.57	-	-	-	-	-	-	-
	86-A-3A	59.00	1.10	19.15	4.60†	-	0.069	2.21	2.48	0.18	3.02	-	-	-	-	-	-	-
	86 A-3B	64.20	0.97	17.10	5.13†	-	0.072	1.52	0.29	0.16	3.02	-	-	-	-	-	-	-
	86-C-2A	68.20	1.01	16.40	3.93†	-	0.019	0.62	0.12	0.15	2.74	-	-	-	-	-	-	-
	86-C-2B	52.70	0.89	21.95	7.90†	-	0.172	1.70	0.39	0.22	4.07	-	-	-	-	-	-	-

Table 12. (Continued)

County	Sample number	SiO ₂	TiO ₂	Al ₂ O ₃	FeO	FeO	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	S ₂ (total)	(org.)	(O)	H ₂ O	H ₂ O ⁺	Volatiles (except H ₂ O, CO ₂)
Fayette	28-C-7	53.90	0.89	19.45	6.52†	-	0.065	1.60	0.84	0.47	3.43	-	-	-	-	-	-	-
	28-D-8A	57.80	1.01	22.30	5.05†	-	0.026	1.20	0.08	0.38	3.38	-	-	-	-	-	-	-
	28-D-8B	52.90	0.92	17.75	8.50†	-	0.109	1.32	0.27	0.53	2.93	-	-	-	-	-	-	-
	29-B-3	53.80	1.05	18.90	8.31†	-	0.153	1.66	0.71	0.19	3.22	-	-	-	-	-	-	-
	29-B-6	48.10	0.76	19.40	5.55†	-	0.10	2.82	3.78	0.23	3.44	-	-	-	-	-	-	-
	29-C-4A	51.00	0.91	19.20	6.40†	-	0.128	2.22	3.12	0.29	3.23	-	-	-	-	-	-	-
	29-C-4B	52.45	0.82	20.65	6.81†	-	0.114	1.48	0.56	0.24	3.38	-	-	-	-	-	-	-
	29-C-5	51.90	0.88	19.50	9.15†	-	0.107	1.81	0.92	0.27	3.29	-	-	-	-	-	-	-
	39-A-1A	71.00	0.87	13.65	6.02†	-	0.086	1.03	0.27	0.31	2.43	-	-	-	-	-	-	-
	39-A-1B	67.55	0.89	14.45	5.80†	-	0.083	1.17	0.34	0.83	2.25	-	-	-	-	-	-	-
	39-A-5A	61.50	1.07	20.05	5.35†	-	0.024	0.91	0.09	0.40	3.15	-	-	-	-	-	-	-
	39-A-5B	46.70	0.84	19.65	7.13†	-	0.026	1.10	0.21	0.25	3.04	-	-	-	-	-	-	-
	39-B-6	58.60	1.07	21.05	7.46†	-	0.116	1.10	0.23	0.18	3.18	-	-	-	-	-	-	-
	39-C-2A	55.80	1.00	18.70	9.18†	-	0.128	1.44	0.44	0.14	2.87	-	-	-	-	-	-	-
	39-C-2B	41.60	0.90	19.95	7.72†	-	0.082	0.68	0.51	0.17	2.19	-	-	-	-	-	-	-
	39-C-2C	57.30	0.91	22.85	2.05†	-	0.014	0.82	0.11	0.22	3.37	-	-	-	-	-	-	-
	39-C-2D	32.10	0.63	12.70	10.16†	-	0.144	1.61	12.82	0.13	1.74	-	-	-	-	-	-	-
	39-C-2H	61.30	1.00	19.80	4.60†	-	0.060	1.58	1.27	0.25	2.92	-	-	-	-	-	-	-
	39-C-2I	57.20	1.00	20.20	8.60†	-	0.071	1.40	1.35	0.20	2.45	-	-	-	-	-	-	-
	39-C-2G	58.05	1.04	16.95	7.60†	-	0.120	1.70	1.76	0.19	2.76	-	-	-	-	-	-	-
	39-C-3	67.50	0.77	14.20	4.70†	-	0.067	1.08	1.72	1.32	2.19	-	-	-	-	-	-	-
	39-C-4	62.20	1.38	16.85	6.43†	-	0.055	1.71	0.77	0.13	3.47	-	-	-	-	-	-	-
	39-C-7	62.70	1.14	22.30	3.24†	-	0.045	0.60	0.25	0.17	2.86	-	-	-	-	-	-	-
	39-D-8	66.40	1.08	15.10	5.22†	-	0.096	1.12	0.27	0.13	2.70	-	-	-	-	-	-	-
	48-C-3	62.40	0.98	17.10	9.50†	-	0.255	0.96	0.21	0.17	3.19	-	-	-	-	-	-	-
	48-C-4	50.20	1.02	21.35	4.40†	-	0.015	0.58	0.14	0.15	2.30	-	-	-	-	-	-	-
	49-A-4A	54.30	0.97	22.20	6.58†	-	0.033	1.25	0.18	0.20	3.63	-	-	-	-	-	-	-
	49-A-4B	53.70	1.19	24.70	5.74†	-	0.028	1.04	0.64	0.19	3.62	-	-	-	-	-	-	-
	49-C-3A	>70.00	1.05	15.70	2.75†	-	0.026	0.97	0.19	0.13	2.66	-	-	-	-	-	-	-
	49-C-3B	46.20	1.31	28.90	4.85†	-	0.026	0.80	0.59	0.21	2.83	-	-	-	-	-	-	-
	49-C-3C	63.20	1.43	24.85	1.89†	-	0.021	0.66	0.24	0.20	3.21	-	-	-	-	-	-	-
	49-C-3D	56.70	0.88	20.50	10.67†	-	0.134	1.08	0.79	0.17	3.23	-	-	-	-	-	-	-
	49-C-3E	51.20	1.60	33.50	2.10†	-	0.014	0.70	0.27	0.15	1.42	-	-	-	-	-	-	-
	140-A-1A	49.90	0.81	15.30	5.11†	-	0.083	1.25	0.54	0.42	2.60	-	-	-	-	-	-	-
	140-B-1B	56.00	1.05	19.55	8.30†	-	0.035	0.91	0.18	0.10	2.23	-	-	-	-	-	-	-

Greene	9-A-7	58.10	0.97	19.40	5.53†	-	-	0.047	1.54	2.09	0.62	3.44	-	-	-	-	-	-	-	-
	9-A-9	57.20	1.02	20.30	7.47†	-	-	0.044	1.63	0.62	0.52	3.36	-	-	-	-	-	-	-	-
	9-B-8	55.60	1.04	19.65	7.04†	-	-	0.039	2.13	2.11	0.52	3.85	-	-	-	-	-	-	-	-
	9-B-10	54.60	0.87	19.85	7.36†	-	-	0.057	1.73	2.46	0.39	3.66	-	-	-	-	-	-	-	-
	9-B-11	55.70	0.90	20.15	7.98†	-	-	0.045	1.80	0.48	0.36	3.85	-	-	-	-	-	-	-	-
	9-C-4	55.80	0.87	19.75	6.93†	-	-	0.09	1.54	2.29	0.35	3.50	-	-	-	-	-	-	-	-
	9-C-5	59.30	0.91	19.20	6.58†	-	-	0.068	1.66	1.48	0.64	3.25	-	-	-	-	-	-	-	-
	9-C-6	54.00	0.97	19.40	7.48†	-	-	0.102	1.90	0.94	0.52	3.48	-	-	-	-	-	-	-	-
	9-D-3	56.20	1.01	19.85	8.13†	-	-	0.063	1.73	0.42	0.61	3.42	-	-	-	-	-	-	-	-
	9-D-12	56.10	1.04	20.50	7.45†	-	-	0.049	2.10	0.55	0.58	3.35	-	-	-	-	-	-	-	-
	9-D-13	52.20	0.98	20.00	9.21†	-	-	0.115	2.30	0.80	0.49	3.70	-	-	-	-	-	-	-	-
	19-A-3	55.90	1.06	22.05	7.14†	-	-	0.076	1.68	0.86	0.36	3.89	-	-	-	-	-	-	-	-
	19-A-8	55.30	1.09	21.40	7.83†	-	-	0.07	1.73	0.56	0.56	3.25	-	-	-	-	-	-	-	-
	19-A-9	55.20	0.98	19.35	7.97†	-	-	0.05	1.77	0.68	0.55	3.72	-	-	-	-	-	-	-	-
	19-A-10	63.30	0.97	18.15	5.19†	-	-	0.008	1.36	0.26	0.17	4.23	-	-	-	-	-	-	-	-
	19-A-11	41.00	0.69	20.05	10.40†	-	-	0.178	1.29	0.49	0.18	2.51	-	-	-	-	-	-	-	-
	19-A-12A	50.40	0.75	17.35	6.23†	-	-	0.075	1.66	7.22	0.38	3.57	-	-	-	-	-	-	-	-
	19-A-12B	55.30	1.40	20.45	7.40†	-	-	0.107	2.45	1.78	0.63	3.70	-	-	-	-	-	-	-	-
	19-A-12C	52.60	0.95	20.75	8.80†	-	-	0.110	2.44	0.93	0.60	3.64	-	-	-	-	-	-	-	-
	19-A-13	57.20	0.94	19.50	6.68†	-	-	0.075	1.54	1.22	0.53	3.65	-	-	-	-	-	-	-	-
19-B-14	60.60	1.29	26.85	2.15†	-	-	0.005	0.67	0.11	0.26	1.91	-	-	-	-	-	-	-	-	
19-D-4A	56.80	1.08	20.25	5.21†	-	-	0.023	1.22	0.33	0.46	3.43	-	-	-	-	-	-	-	-	
19-D-4B	70.20	0.82	14.40	5.41†	-	-	0.077	1.20	0.53	1.82	1.95	-	-	-	-	-	-	-	-	
19-D-4C	66.20	0.88	16.05	6.40†	-	-	0.048	1.50	0.57	1.53	2.42	-	-	-	-	-	-	-	-	
19-D-4D	43.20	0.65	15.00	5.97†	-	-	0.146	1.97	13.00	0.39	3.22	-	-	-	-	-	-	-	-	
19-D-4E	50.70	0.77	15.60	6.15†	-	-	0.114	2.0	7.76	0.39	3.69	-	-	-	-	-	-	-	-	
19-D-4F	64.30	0.97	15.50	5.40†	-	-	0.052	1.56	1.05	1.32	2.42	-	-	-	-	-	-	-	-	
19-D-5A	63.10	0.95	18.70	7.15†	-	-	0.077	1.58	0.50	0.84	3.07	-	-	-	-	-	-	-	-	
19-D-5B	>70.00	0.86	11.75	5.50†	-	-	0.127	1.11	4.28	1.37	1.65	-	-	-	-	-	-	-	-	
19-D-5C	50.80	0.85	14.85	10.54†	-	-	0.147	2.17	4.72	0.68	2.39	-	-	-	-	-	-	-	-	
29-A-7	58.40	1.07	18.00	7.50†	-	-	0.091	1.70	0.58	1.00	2.97	-	-	-	-	-	-	-	-	
110-A-5	47.40	0.75	16.10	5.75†	-	-	0.135	1.40	7.70	0.42	3.28	-	-	-	-	-	-	-	-	
110-B-3	57.20	1.12	17.70	5.65†	-	-	0.083	1.47	0.32	0.42	3.19	-	-	-	-	-	-	-	-	
110-B-4A	55.80	1.02	19.95	8.00†	-	-	0.144	1.59	0.47	0.45	3.74	-	-	-	-	-	-	-	-	
110-B-4B	41.90	0.67	14.55	15.92†	-	-	0.442	1.83	1.10	0.24	2.30	-	-	-	-	-	-	-	-	
120 A 1	42.70	0.65	13.95	5.78†	-	-	0.526	1.86	14.80	0.29	2.61	-	-	-	-	-	-	-	-	
120-A-2	51.20	0.92	19.55	8.00†	-	-	0.227	1.82	0.75	0.31	3.26	-	-	-	-	-	-	-	-	
120-A-3	57.00	0.98	19.55	7.97†	-	-	0.117	1.65	2.70	0.14	3.16	-	-	-	-	-	-	-	-	
120-A 4	55.50	0.92	18.20	7.10†	-	-	0.031	2.00	0.30	0.15	3.08	-	-	-	-	-	-	-	-	
120-A-5	48.70	0.98	19.10	9.20†	-	-	0.052	1.90	0.40	0.19	3.20	-	-	-	-	-	-	-	-	

Table 12. (Continued)

County	Sample number	SiO ₂	TiO ₂	Al ₂ O ₃	Fe ₂ O ₃	FeO	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	S (total)	C (org)	CO ₂	H ₂ O	H ₂ O +	Volatiles (except H ₂ O, C (O))
Indiana	46-C-6	62.00	1.06	17.25	8.68†	-	0.098	2.02	0.55	0.64	2.70	-	-	-	-	-	-	-
	46-D-3	61.40	1.00	16.70	7.47†	-	0.101	1.69	0.20	0.63	2.78	-	-	-	-	-	-	-
	46-D-4	64.40	0.94	17.00	7.50†	-	0.126	1.68	0.12	0.85	2.56	-	-	-	-	-	-	-
	46-D-5	56.40	0.89	19.00	8.23†	-	0.136	2.04	0.50	0.70	2.85	-	-	-	-	-	-	-
	46-D-7	63.70	1.02	18.05	7.20†	-	0.084	1.82	0.50	0.77	2.45	-	-	-	-	-	-	-
	47-B-4	53.40	0.80	19.95	7.74†	-	0.135	2.03	0.43	0.96	3.15	-	-	-	-	-	-	-
	47-B-5	60.70	0.88	17.85	6.75†	-	0.078	2.13	0.31	0.74	2.85	-	-	-	-	-	-	-
	55-C-2	58.80	0.82	19.30	7.78†	-	0.087	1.53	0.08	0.35	3.28	-	-	-	-	-	-	-
	55-D-1A	59.60	1.11	19.50	7.34†	-	0.058	2.10	0.31	0.62	3.30	-	-	-	-	-	-	-
	55-D-1B	52.40	0.87	20.75	8.20†	-	0.131	2.25	0.25	0.55	3.69	-	-	-	-	-	-	-
	56-A-8	54.90	0.95	19.60	8.10†	-	0.086	1.84	0.30	0.42	3.33	-	-	-	-	-	-	-
	56-A-9	60.20	0.95	19.90	7.55†	-	0.054	2.13	0.15	0.62	3.38	-	-	-	-	-	-	-
	56-A-11	58.10	1.01	18.20	7.95†	-	0.141	1.56	0.14	0.22	3.15	-	-	-	-	-	-	-
	56-B-1	67.60	2.20	17.80	2.88†	-	0.019	0.71	0.17	0.18	2.47	-	-	-	-	-	-	-
	56-B-2	>75.00	1.51	22.30	2.43†	-	0.018	1.00	0.10	0.17	2.85	-	-	-	-	-	-	-
	56-B-3	58.00	1.18	22.25	4.10†	-	0.026	1.44	0.36	0.23	3.78	-	-	-	-	-	-	-
	56-B-4	>70.00	1.63	15.95	1.12†	-	0.007	0.50	0.00	0.15	2.34	-	-	-	-	-	-	-
	56-B-5	56.20	2.17	25.30	0.69†	-	0.006	0.25	0.10	0.06	0.90	-	-	-	-	-	-	-
	56-B-6A	50.60	0.78	19.50	8.85†	-	0.059	2.22	0.33	0.64	3.39	-	-	-	-	-	-	-
	56-B-6B	55.90	0.83	20.00	8.70†	-	0.175	2.11	0.61	0.69	3.40	-	-	-	-	-	-	-
	56-B-6C	59.30	0.92	19.65	7.55†	-	0.063	2.08	0.28	0.76	3.28	-	-	-	-	-	-	-
	56-B-7	63.70	0.97	17.50	7.50†	-	0.044	2.05	0.25	0.40	2.85	-	-	-	-	-	-	-
	56-B-12	54.10	0.94	18.25	7.86†	-	0.120	1.63	0.31	0.20	3.31	-	-	-	-	-	-	-
	56-D-10	61.00	0.98	18.05	6.13†	-	0.066	1.23	0.03	0.16	3.19	-	-	-	-	-	-	-
	57-A-6	52.60	0.90	18.85	8.60†	-	0.111	2.18	1.53	0.38	3.38	-	-	-	-	-	-	-
	57-B-7	55.80	1.14	22.75	3.70†	-	0.029	1.10	0.31	0.24	3.47	-	-	-	-	-	-	-
	65-C-2A	60.60	1.07	21.75	3.00†	-	0.019	1.05	0.22	0.15	3.80	-	-	-	-	-	-	-
	65-C-2B	61.10	1.08	16.10	7.50†	-	0.122	1.40	0.32	0.16	2.43	-	-	-	-	-	-	-
	65-C-3	57.50	0.92	19.10	8.08†	-	0.136	2.16	0.38	0.50	3.63	-	-	-	-	-	-	-
	65-D-2	62.80	1.03	18.75	7.44†	-	0.126	1.57	0.32	0.25	2.65	-	-	-	-	-	-	-
	66-A-1	65.10	1.18	21.35	2.18†	-	0.022	0.84	0.21	0.14	2.65	-	-	-	-	-	-	-
	66-C-2	51.00	0.85	20.45	8.58†	-	0.093	2.15	0.22	0.48	3.71	-	-	-	-	-	-	-
Lawrence	4-C-1A	60.30	1.04	18.50	6.04†	-	0.05	1.36	0.16	0.17	3.17	-	-	-	-	-	-	-
	4-C-1B	60.10	1.38	22.30	1.85†	-	0.013	0.77	0.13	0.18	3.52	-	-	-	-	-	-	-
	4-C-2A	53.70	0.95	22.40	7.00†	-	0.040	1.04	0.52	0.21	3.77	-	-	-	-	-	-	-

Table 12. (Continued)

County	Sample number	SiO ₂	TiO ₂	Al ₂ O ₃	Fe ₂ O ₃	FeO	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	S (total)	(org.)	CO	H ₂ O	H ₂ O +	Volatiles (except H ₂ O, CO)
Somerset	58-D-10	58.50	1.08	20.60	5.23†	-	0.08	1.12	0.17	0.24	3.38	-	-	-	-	-	-	-
	58-D-11	41.90	0.85	16.45	5.00†	-	0.04	0.76	0.51	0.13	2.06	-	-	-	-	-	-	-
	58-D-12	54.20	1.15	20.30	6.68†	-	0.08	0.91	0.28	0.17	2.87	-	-	-	-	-	-	-
	58-D-13	60.10	1.23	21.00	4.28†	-	0.02	1.05	0.11	0.15	3.37	-	-	-	-	-	-	-
	59-A-5	57.60	1.02	18.65	8.42†	-	0.14	1.29	0.42	0.18	2.88	-	-	-	-	-	-	-
	59-A-6	68.00	1.08	16.65	3.45†	-	0.03	0.85	0.22	0.14	2.45	-	-	-	-	-	-	-
	59-A-12	51.40	0.86	20.75	8.98†	-	0.55	2.07	1.77	0.21	3.18	-	-	-	-	-	-	-
	59-A-13	56.00	0.97	21.25	7.80†	-	0.14	1.85	0.55	0.24	3.48	-	-	-	-	-	-	-
	59-A-14	45.00	0.81	14.30	19.30†	-	0.48	1.77	1.45	0.10	2.08	-	-	-	-	-	-	-
	59-A-15	66.60	1.20	19.25	3.17†	-	0.01	0.61	0.13	0.18	2.58	-	-	-	-	-	-	-
	59-A-16	60.90	1.21	20.35	4.80†	-	0.07	0.80	0.06	0.19	3.28	-	-	-	-	-	-	-
	59-B-7	65.50	1.23	16.80	4.20†	-	0.04	1.13	0.15	0.15	2.70	-	-	-	-	-	-	-
	59-B-8	69.90	1.18	18.35	1.90†	-	0.02	0.80	0.10	0.16	2.58	-	-	-	-	-	-	-
	59-B-9	63.80	1.05	19.05	4.87†	-	0.04	1.19	0.11	0.18	3.14	-	-	-	-	-	-	-
	59-B-10	65.70	1.07	17.45	3.90†	-	0.04	1.25	0.12	0.17	2.93	-	-	-	-	-	-	-
	59-B-11	70.10	1.17	17.10	2.40†	-	0.02	0.80	0.11	0.15	2.28	-	-	-	-	-	-	-
	59-D-17	50.70	0.97	17.95	11.80†	-	0.25	0.81	0.56	0.17	2.62	-	-	-	-	-	-	-
	59-D-18	56.80	1.03	18.75	8.10†	-	0.18	0.18	0.54	0.18	2.94	-	-	-	-	-	-	-
	59-D-19	62.00	1.10	18.40	4.75†	-	0.08	0.72	0.58	0.18	2.87	-	-	-	-	-	-	-
	59-D-20	49.30	0.84	22.60	5.30†	-	0.02	0.85	0.51	0.27	3.07	-	-	-	-	-	-	-
	59-D-21	48.30	0.93	21.65	4.10†	-	0.03	0.73	0.21	0.25	2.88	-	-	-	-	-	-	-
	59-D-22	63.10	1.08	21.10	2.70†	-	0.013	0.53	0.34	0.23	2.44	-	-	-	-	-	-	-
	59-D-23	57.70	1.07	21.00	5.55†	-	0.085	0.93	0.31	0.25	3.41	-	-	-	-	-	-	-
	59-D-24	58.50	1.00	19.35	6.70†	-	0.13	0.79	0.39	0.18	3.13	-	-	-	-	-	-	-
	59-D-25	48.50	0.80	19.15	8.86†	-	0.33	0.83	3.20	0.17	2.52	-	-	-	-	-	-	-
	68-A-11	61.70	1.12	20.50	4.60†	-	0.04	0.76	0.24	0.25	3.33	-	-	-	-	-	-	-
	68-B-10	56.70	0.98	21.90	5.35†	-	0.03	0.89	0.08	0.16	3.46	-	-	-	-	-	-	-
	68-C-6	59.70	1.07	19.85	5.35†	-	0.08	1.30	0.26	0.18	3.22	-	-	-	-	-	-	-
	68-C-7	68.10	1.02	19.70	4.85†	-	0.08	1.09	0.13	0.18	3.44	-	-	-	-	-	-	-
	68-C-8	55.50	1.15	22.10	5.10†	-	0.02	0.62	0.24	0.18	2.52	-	-	-	-	-	-	-
	68-C-9	47.70	0.98	20.80	7.78†	-	0.11	1.12	0.23	0.17	2.98	-	-	-	-	-	-	-
	68-D-1	33.00	0.56	15.75	9.47†	-	0.10	0.82	0.49	0.13	2.12	-	-	-	-	-	-	-
	68-D-2	66.00	1.38	21.65	1.70†	-	0.01	0.83	0.20	0.17	3.25	-	-	-	-	-	-	-
	68-D-3	58.20	0.99	22.70	3.28†	-	0.02	1.18	0.61	0.22	4.05	-	-	-	-	-	-	-
	68-D-4	50.60	0.91	18.35	3.00†	-	0.05	2.23	10.05	0.15	2.41	-	-	-	-	-	-	-

Table 12. (Continued)

County	Sample number	SiO ₂	TiO ₂	Al ₂ O ₃	Fe ₂ O ₃	FeO	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	S(total)	C(org.)	CO ₂	H ₂ O -	H ₂ O +	Volatiles (except H ₂ O, CO ₂)
	*28-B 6P	54.7	0.91	19.8	2.5	5.9	0.23	2.4	0.61	0.68	3.1	0.12	0.27	0.55	1.4	0.83	5.7	0.0
	*28-B 6Q	43.6	0.66	14.5	5.0	1.9	0.31	1.7	14.5	0.37	2.3	0.11	0.01	0.02	10.5	1.2	4.1	0.3
	*28-B-6R	46.9	0.79	16.5	4.9	2.5	0.11	1.9	8.3	0.41	3.0	0.41	1.9	0.18	7.0	1.4	5.0	0.0
	*28-B-6S	40.2	0.56	13.3	3.1	1.9	0.15	3.8	14.8	0.34	2.6	0.17	0.01	0.13	14.5	1.1	3.5	0.0
	*28-B-6T	58.5	0.96	19.2	3.0	4.0	0.03	1.8	1.1	0.41	2.8	0.28	0.01	0.09	1.1	0.64	5.5	0.0
	*28-B-6U	49.2	0.8	20.6	2.9	6.1	0.09	2.5	1.5	0.38	3.5	0.28	1.7	1.2	2.5	0.79	6.0	0.60
	*28-B 6V	63.2	0.86	17.7	1.6	4.0	0.04	1.9	0.42	0.90	2.6	0.20	0.03	0.71	0.35	0.45	4.6	0.0
	*28-B-6W	62.0	0.94	16.6	2.2	4.0	0.02	2.1	0.41	1.2	3.2	0.12	0.84	1.1	0.45	0.66	4.1	1.4
	36-C-1	53.2	0.93	19.25	9.00†	-	0.12	1.75	3.04	0.13	3.61	-	-	-	-	-	-	-
	36-D 3	48.8	1.15	21.25	5.00†	-	0.01	0.69	0.26	0.16	2.37	-	-	-	-	-	-	-
	37-A-1	58.4	1.16	20.35	6.48†	-	0.03	1.12	0.42	0.18	3.68	-	-	-	-	-	-	-
	*38-A-5	51.4	0.92	20.6	3.6	5.9	0.20	2.0	0.73	0.46	3.1	0.16	1.2	1.5	2.8	0.81	6.5	-
	*38-B-1	54.7	1.0	19.8	3.0	4.4	0.08	2.0	0.92	0.18	3.1	0.14	1.1	0.21	2.3	1.1	6.5	-
	*38-B-2B	57.4	1.0	20.0	4.5	0.68	0.01	1.3	0.74	0.14	5.0	0.06	2.9	0.40	0.08	1.9	5.6	-
	*38-B 3A	54.2	0.74	16.6	2.3	1.2	0.03	1.6	7.2	0.12	3.0	0.38	0.78	0.29	5.4	1.6	5.0	-
	*38-B-3B	55.6	1.0	20.5	2.6	4.0	0.07	2.1	1.1	0.07	3.2	0.17	0.36	1.2	2.1	1.0	6.4	-
	*38-B-4	58.8	0.94	24.0	1.2	0.92	0.09	0.98	0.35	0.06	3.3	0.22	0.14	0.74	0.02	1.4	7.4	-
	47-A-3	59.5	1.02	19.05	7.92†	-	0.10	2.66	0.57	1.18	2.82	-	-	-	-	-	-	-
	47-B-31	49.9	0.80	16.15	5.78†	-	0.09	2.50	8.30	0.43	2.94	-	-	-	-	-	-	-
	47-B-3K	53.0	0.90	18.55	6.15†	-	0.06	2.12	5.23	0.45	3.09	-	-	-	-	-	-	-
	47-B-31	49.3	0.83	21.10	11.50†	-	0.42	1.77	0.76	0.41	3.74	-	-	-	-	-	-	-
	47-B-3M	53.9	1.06	19.80	6.00†	-	0.15	1.83	4.26	0.44	3.27	-	-	-	-	-	-	-
	47-B-3N	59.2	1.04	18.75	7.48†	-	0.06	1.67	0.46	0.50	3.17	-	-	-	-	-	-	-
	47-B-3O	61.1	1.05	17.30	5.70†	-	0.05	1.22	1.13	0.29	2.52	-	-	-	-	-	-	-
	47-B-3P	53.4	1.02	19.20	8.72†	-	0.10	2.00	0.69	0.29	3.25	-	-	-	-	-	-	-
	47-B-3R	50.2	0.92	17.60	11.20†	-	0.22	0.98	3.90	0.27	2.03	-	-	-	-	-	-	-
	47-B-3S	54.2	1.07	19.20	9.78†	-	0.09	1.74	2.11	0.28	3.04	-	-	-	-	-	-	-
	47-B-3W	57.2	1.19	19.50	6.60†	-	0.04	0.84	0.41	0.32	3.00	-	-	-	-	-	-	-
	47-B-3X	58.6	1.02	22.90	4.70†	-	0.03	1.32	0.20	0.35	4.14	-	-	-	-	-	-	-
	*47-C-2	55.0	1.0	21.1	6.3	1.0	0.03	1.0	0.34	0.16	3.6	0.15	4.1	1.3	0.02	1.4	7.1	-
	*48-A-2	54.2	1.6	24.6	3.7	0.65	0.01	0.42	0.09	0.14	2.5	0.19	2.0	1.5	0.01	1.5	8.4	-
	57-A-3	62.6	1.28	21.85	2.55†	-	0.01	0.88	0.21	0.16	3.52	-	-	-	-	-	-	-
	57-C-4	54.3	0.90	16.60	6.00†	-	0.16	1.65	6.30	0.17	3.10	-	-	-	-	-	-	-
	57-C-5	57.5	0.99	17.70	7.97†	-	0.18	1.82	0.50	0.70	2.92	-	-	-	-	-	-	-

Westmoreland

*Samples analyzed by the U. S. Geological Survey; samples without asterisk were analyzed by the Pennsylvania Bureau of Topographic and Geologic Survey.

†Total iron expressed as Fe₂O₃.

Table 13. Assumed Values, in Percent, of Materials Used as Standards for Chemical Analyses
by the Pennsylvania Bureau of Topographic and Geologic Survey

Material	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MgO	CaO	Na ₂ O	K ₂ O	TiO ₂	MnO
Blank				0.00	0.00	0.00	0.00	0.00	0.000
AGV-1		17.24		1.54	4.95	4.28			0.096
BCR-1		13.64	13.46	3.47	6.95	3.28	1.69	2.21	0.180
Earth Avg.				2.49	3.09	1.29		0.77	
G-2	69.15	15.38	2.66	0.76	1.96		4.51	0.50	0.034
GSP-1	67.35		4.33			2.80	5.53		
Mica-Fe									0.350
Mica-Mg								1.67	0.242
PCC-1	42.03	0.74	8.32	1.11	0.85	0.67	3.29	1.00	0.116
Pa. Avg.		18.91	6.29						
Shp-1	60.46		6.97						
W-1	52.68		11.10	6.62	10.97	2.15	0.64	1.07	0.167
98a*	48.94	33.19		0.42	0.31	0.082	1.04		
56-316†	61.40	20.48					3.65		

* Analyzed plastic clay (shale from Clearfield County, Pa.), Office of Standard Reference Materials, National Bureau of Standards, Washington, D. C.

† Analyzed shale, Mineral Constitution Laboratory, Pennsylvania State University, University Park, Pa.

values selected for the "Pennsylvania Average Shale" are based on the results reported by O'Neill and others (1965); those for the "Earth Average Shale" are based on values given by Turekian and Wedepohl (1961). The reagents used were SiO₂ (optical quality Brazil quartz), Al₂O₃, Fe₂O₃, MgO, CaCO₃, Na₂CO₃, TiO₂, CaHPO₄, and MnO₂. The assumed concentrations, and those obtained by atomic absorption analysis, are presented in Table 14.

Table 14. *Synthetic "Shale" Standards*

Oxide	PENNSYLVANIA AVERAGE SHALE		EARTH AVERAGE SHALE	
	Intended conc.	Analyzed conc.	Intended conc.	Analyzed conc.
SiO ₂	60.40%	62.50%	58.42%	62.20%
Al ₂ O ₃	18.91	18.60	15.11	15.72
Fe ₂ O ₃	6.29	6.51	6.75	7.16
MgO	1.11	1.13	2.49	2.47
CaO	0.85	0.83	3.09	3.18
Na ₂ O	0.67	0.72	1.29	1.37
K ₂ O	3.29	3.31	3.20	3.21
TiO ₂	1.00	1.02	0.77	0.78
P ₂ O ₅	0.15	- -	0.16	- -
MnO	0.20	0.169	0.110	0.120

Prior to the start of the analyses of the clay and shale samples, complete or partial analyses were performed on 22 international reference rock samples to test the procedure. The results obtained were compared with those commonly accepted (see Flanagan, 1970, and Abbey, 1972). These results, presented in Table 15, generally show good agreement.

The samples were prepared in batches of 21. Half of the standards were freshly fused with each group of samples, and fresh dilutions of all the standards were prepared each time a new group of samples was to be run. Samples were analyzed on the morning following fusion and dilution. The samples were run in groups of seven, alternating between aspiration of samples and standards. All runs were repeated in reverse order to compensate for drift, and the readings obtained from two runs were averaged for calculations of concentration. Calculation was carried out by hand-plotting absorbance versus concentration of the standards to obtain a new calibration curve for each group of seven samples. Most calibration curves were nearly linear. In cases where the curve was nonlinear, a best fit was estimated, and the curve was drawn using a standard irregular curve as a guide. For those elements for which the blank standard produced a measurable reading (e.g., K, Ca, Na) the calibration curve was drawn in such a manner that it did not pass through the origin. Instead, the absorbance, or emission, measured from the blank was taken to represent zero percent concentration.

The precision for the analyses, taken as one standard deviation of the scatter of the standard data points plotted on each side of the calibration

Table 15. Atomic Absorption Analyses of International Reference Samples

	SiO ₂ %	TiO ₂ %	Al ₂ O ₃ %	Fe ₂ O ₃ %	MnO %	CaO %	MgO %	K ₂ O %	Na ₂ O %
BD-1	Rpt. *	48.9	17.22	10.13	0.17	12.64	7.82	0.21	1.95
	Obs. †	48.3	17.20	10.07	0.161	12.48	7.82	0.18	1.95
BR	Rpt.	38.3	10.22	12.93	0.199	13.85	13.31	1.40	3.06
	Obs.	38.1	10.15	12.75	0.195	13.92	13.25	1.39	2.98
BX-N	Rpt.	7.36	54.36	23.21	0.04	0.25	0.13	0.07	0.09
	Obs.	5.0	>45	21.43 >>15	0.048 0.039	0.17 0.13	0.08 0.05	0.02 0.00	0.01 0.01
DR-N	Rpt.		17.42	9.80	0.21	7.08	4.48	1.70	3.00
	Obs.		17.40	9.39	0.210	7.06	4.22	1.94	2.97
DT-N	Rpt.		59.03	0.67	0.008	0.16	0.10	0.12	0.04
	Obs.		>45	0.53	0.005	0.02	0.01	0.06	0.02
GA	Rpt.	69.9	14.50	2.85	0.09	2.45	0.95	4.03	3.55
	Obs.	65.2(?)	14.50	2.6(?)	0.083	2.44	0.90	4.18	3.48
GH	Rpt.	75.8	12.50	1.34	0.049	0.69	0.03	4.76	3.85
	Obs.	>70	12.60	1.24	0.049	0.70	0.01	4.99	3.86
JB-1	Rpt.	52.3	14.60	9.09	0.16	9.25	7.74	1.42	2.80
	Obs.	51.0	14.20	8.69	0.150	9.33	7.74	1.42	2.76

Table 15. (Continued)

	SiO ₂ %	TiO ₂ %	Al ₂ O ₃ %	Fe ₂ O ₃ %	MnO %	CaO %	MgO %	K ₂ O %	Na ₂ O %
JG-1	Rpt.	0.26	14.22	2.21	0.06	2.18	0.73	3.96	3.39
	Obs.	0.28	13.90	2.03	0.063	2.15	0.72	4.10	3.43
Mica-Fe	Rpt.	34.4	19.4	25.8	0.35	0.45	4.6(?)	8.8(?)	0.30
	Obs.	33.7	18.26	22.98	0.323	0.42	4.55	>8	0.27
Mica-Mg	Rpt.				0.347		4.54	>6	0.24
	Obs.				0.26	0.10(?)	20.40		
NIM-D	Rpt.		15.40	9.61	0.242	0.00	19.65		
	Obs.		14.75	9.20	0.205		43.49		
NIM-G	Rpt.	39.0			0.219		42.50		
	Obs.	39.8			0.02				
NIM-L	Rpt.				0.018				
	Obs.				0.76			5.53	8.35
NIM-N	Rpt.	52.6			>0.5			5.48	>7
	Obs.	52.3			0.175		7.50		
NIM-P	Rpt.	52.5			0.177		7.25		
	Obs.	52.4			0.215		25.27		
	Rpt.	51.0			0.215		24.80		
	Obs.	51.2			0.215				

Shp-I	Rpt.	60.46	0.92	17.72	6.97	0.09(?)	0.48	1.95	3.15	1.24
	Obs.	60.5	0.89 0.90	17.30	7.12	0.094 0.096	0.49	2.03	3.20	1.25
SU-I	Rpt.		0.81			0.11				
	Obs.		0.77			0.126				
T-I	Rpt.	62.7	0.59	0.59		0.11				
	Obs.	63.5	0.54			0.096				
UB-N	Rpt.		0.12			0.12		35.00		
	Obs.		0.13			0.121		34.80		
VS-N	Rpt.	55.7(?)	(?)			0.1(?)				
	Obs.	57.9	1.01			0.097				
56-316	Rpt.	61.40	1.01	20.48	3.90	0.04	0.24	1.73	3.65	0.17
	Obs.	60.5 61.6	1.27 1.02	19.20	3.82	0.039 0.037	0.22	1.73	3.80	0.18

*Rpt. = Assumed value reported by Flanagan (1970) or Abbey (1972).

†Obs. = Observed value.

curve, is typically as follows: SiO_2 , $\pm 0.4\%$; Al_2O_3 , $\pm 0.1\%$; Fe_2O_3 , $\pm 0.05\%$; MgO , $\pm 0.02\%$; CaO , $\pm 0.02\%$; Na_2O , $\pm 0.03\%$; K_2O , $\pm 0.02\%$; TiO_2 , $\pm 0.01\%$; MnO_2 , $\pm 0.001\%$.

A possible indicator of the degree of accuracy achieved can be obtained by examination of the values obtained in analysis of the international reference samples (Table 15).

TRACE-ELEMENT ANALYSES

The Branch of Analytical Laboratories of the U. S. Geological Survey performed routine, semiquantitative emission-spectrographic analyses for 59 elements for each of the 160 samples identified by asterisks in Table 12. Two of the elements (mercury and arsenic), although included among the 59, were in most cases run again using different methods. Mercury was determined in the case of all 160 samples by combustion in oxygen, trapping on platinum, heating to release Hg, and reading absorbance of Hg vapor. In the case of arsenic, the concentration of arsenic in 128 samples was determined by fusing each sample in the presence of As^{76} tracer, evolving the hydride with zinc, developing the molybdenum blue color, and making a recovery yield correction by counting the tracer. In addition, the carbon concentration in 128 of these 160 samples was determined by the classical combustion, absorption, gravimetric technique.

The Pennsylvania Bureau of Topographic and Geologic Survey contracted with Skyline Laboratories, Inc., Wheat Ridge, Colorado, to perform semiquantitative emission-spectrographic analyses for 31 elements, on splits of the 253 clay-shale samples not analyzed by the U. S. Geological Survey.

All trace-element analyses were screened to identify concentrations that were believed to be departures from the normal, i.e., anomalous values. These are summarized in Table 16. The complete tabulation of trace-element concentrations is available on open file under the titles: (1) Open-File Material, Mineral Resource Report 71, Part 2, and (2) Open File Material, Mineral Resource Report 77. Microfilm copies of these data can be obtained for a nominal charge from the Pennsylvania Bureau of Topographic and Geologic Survey in Harrisburg, Pennsylvania. The open-file material is available for examination at the following places: Pennsylvania Bureau of Topographic and Geologic Survey, Room 914, Executive House, Second and Chestnut Streets, Harrisburg, Pennsylvania; and Pennsylvania Bureau of Topographic and Geologic Survey, 1201 Kossman Building, Forbes Avenue and Stanwix Street, Pittsburgh, Pennsylvania.

Anomalous concentrations of elements may have economic significance, because they have been used successfully in places to locate mineral deposits. They also play an important environmental role because certain elements, in abnormally high concentrations, are toxic.

Table 16. Summary of Anomalous or Possibly Anomalous Concentrations of Trace Elements

County	Sample number*	Anomalous or possibly anomalous concentrations (in parts per million)
Allegheny	17-B-3B	Pb 101; Sn 7
Do.	27-C-10B	Pb 93; Sn 7
Do.	27-C-11C	Pb 175; Sn 10
Armstrong	35-B-5	Li 273
Beaver	5-C-28	Sn 7; Li 213
Do.	5-D-11	Pb 103; Sn 7
Butler	24-B-4B	Sn 7
Do.	24-C-2A	Li 255
Do.	24-C-3	Zn 229
Cambria	76-A-2B	Ni 100
Do.	76-B-7	Pb 100
Fayette	48-C-3	Co 100
Do.	48-C-4	Ba 1,500
Greene	19-A-3	Ba 1,500
Indiana	57-B-7	Ni 100
Lawrence	5-B-32A	Zr 500
Washington	7-B-3A	Pb 168; Sn 11
Westmoreland	28-B-6U	Ba 960; Li 164; Ni 65
Do.	37-A-1	Sr 1000
Do.	38-B-3B	Pb 1000; Sb 200; Sn 63

*Refer to Plate 1 for location of sample and to the sample data included in the section titled "Sample Data and Test Results" for a description of the material and its position in the stratigraphic column.

SAMPLE DATA AND TEST RESULTS

The descriptive data and test results are presented separately for each sample. The order of presentation is by county and sample number. Locations for all samples are shown on Plate 1.

A word of caution: the potential uses are based on the test results obtained for one or a few samples from the same stratigraphic interval at each locality. Detailed exploration, including additional sampling and testing, should be carried out in order to assess the quantity and quality of the raw material before commercial development is undertaken.

The key to the abbreviations used on the data sheets follows:

L. O. I.: Loss on ignition

Mod.: Moderate

N. D.: Not determined

P. C. E.: Pyrometric cone equivalent

% Total shk.: Percent total shrinkage

% Absorb.: Percent absorption

% App. Por.: Percent apparent porosity

ALLEGHENY COUNTY Findlay Twp. Aliquippa quad.

Sample number 6-D-16

Location: Exposure northeast of the road intersection at McAlisters Crossroads.

Latitude: 40°30'56"N Longitude: 80°16'04"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Underclay to the Pittsburgh coal consisting of light-gray plastic clay in the upper 0.9 foot (0.3 m) and gray semiplastic silty clay in the remaining portion. Lower portion is also limy and has iron staining on fracture surfaces. Bottom of sample is in contact with limestone.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel through 2.4 feet (0.7 m) of underclay

Chemical analysis:		Mineralogy (X-ray):	
	%		%
SiO ₂	62.5	Quartz	23
TiO ₂	1.0	Mica	63
Al ₂ O ₃	18.9	Kaolinite	8
Fe ₂ O ₃	4.1	Chlorite-	
FeO	0.76	vermiculite	0
MnO	0.01	Feldspar	1
MgO	1.0	Montmorillonite	5
CaO	0.44	Calcite	0
Na ₂ O	0.20		
K ₂ O	2.8		
P ₂ O ₅	0.27		
S (total)	0.05	Raw properties:	
C (org.)	0.52		Water of plasticity (%): 25.5
CO ₂	0.07		Drying shrinkage (%): 5.0
H ₂ O ⁻	1.9		Workability: Plastic
H ₂ O ⁺	4.3		Dry strength: Good
Volatiles			Drying defects: None
(excl. H ₂ O, CO ₂)	1.4		pH: 6.4

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Orange tan	3	5.0	19.7	33.3	1.69
982						
1900	Orange tan	3	5.0	17.7	31.8	1.80
1038						
2000	Red tan	4	10.0	8.3	17.2	2.06
1093						
2100	Red brown	4	15.0	5.2	11.1	2.15
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). High shrinkage.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe.

ALLEGHENY COUNTY Findlay Twp. Aliquippa quad.Sample number **6-D-17**

Location: Exposure on the east side of Flaugherty Run Road, about 1.2 miles (1.9 km) south-southwest of McAlisters Crossroads.

Latitude: 40°30'01"N

Longitude: 80°16'33"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Section below the Pittsburgh coal consisting of interbedded limy claystones, impure shales, and some thin limestone beds. Shales and claystones are predominantly gray to dark gray.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel through 7.4 feet (2.3 m) of section below Pittsburgh coal

Chemical analysis:**Mineralogy (X-ray):**

	%
SiO ₂	44.7
TiO ₂	0.74
Al ₂ O ₃	15.8
Fe ₂ O ₃	1.7
FeO	1.2
MnO	0.07
MgO	1.2
CaO	13.4
Na ₂ O	0.18
K ₂ O	1.9
P ₂ O ₅	0.62
S (total)	0.38
C (org.)	2.3
CO ₂	10.3
H ₂ O ⁻	1.3
H ₂ O ⁺	5.9
Volatiles (excl. H ₂ O, CO ₂)	0.40

	%
Quartz	14
Mica	65
Kaolinite	11
Chlorite- vermiculite	2
Feldspar	1
Montmorillonite	0
Calcite	7

Raw properties:

Water of plasticity (%): 24.5
Drying shrinkage (%): 5.0
Workability: Short
Dry strength: Poor
Drying defects: None
pH: 7.4

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Salmon	No bond	--	--	--	--
982						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1900	Salmon	2	5.0	43.1	53.8	1.25
1038						
2000	Salmon	2	5.0	36.8	49.4	1.34
1093						
2100	Buff	2	5.0	35.7	49.4	1.38
1149						
2200	Light brown	5	10.0	19.8	33.3	1.68
1204						
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Abrupt vitrification (2100–2200°F). Highly effervescent with HCl.

Potential uses: Not suitable for use in vitreous clay products.

ALLEGHENY COUNTY Moon Twp. Ambridge quad.

Sample number 16-C-7

Location: Exposure on the west side of Flaugherty Run Road, about 1200 feet (370 m) south of its intersection with Purdy Road.

Latitude: 40°32'35"N

Longitude: 80°13'06"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-dark-gray limy claystone that breaks down into hackly shaped fragments. Layer of siderite nodules occurs just below bottom contact of sampled interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 13.5 feet (4.1 m) of claystone

Chemical analysis:

Mineralogy (X-ray):

	%		%
SiO ₂	56.6	Quartz	18
TiO ₂	0.98	Mica	71
Al ₂ O ₃	20.0	Kaolinite	0
Fe ₂ O ₃	4.8	Chlorite-	
FeO	1.4	vermiculite	2
MnO	0.07	Feldspar	2
MgO	1.8	Montmorillonite	6
CaO	1.3	Calcite	1

Chemical analysis:

	%
Na ₂ O	0.33
K ₂ O	3.8
P ₂ O ₅	0.16
S (total)	0.06
C (org.)	0.38
CO ₂	0.08
H ₂ O ⁻	2.0
H ₂ O ⁺	5.6
Volatiles (excl. H ₂ O, CO ₂)	0.60

Raw properties:

Water of plasticity (%): 19.0
Drying shrinkage (%): 5.0
Workability: Plastic
Dry strength: Good
Drying defects: None
pH: 4.5

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Tan	2	5.0	13.1	24.8	1.89
982						
1900	Orange tan	3	7.5	8.7	17.8	2.05
1038						
2000	Dark tan	4	10.0	3.0	6.8	2.29
1093						
2100	Red brown	5	10.0	0.2	0.5	2.04
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Fair color at 2100°F.**Potential uses:** Grade SW building brick; Type L floor brick.**ALLEGHENY COUNTY Moon Twp. Ambridge quad.**Sample number **16-C-8****Location:** Exposure on the west side of Flaugherty Run Road, about 1200 feet (370 m) south of its intersection with Purdy Road.**Latitude:** 40°32'35"N**Longitude:** 80°13'06"W**Geologic unit:** Glenshaw Formation, Conemaugh Group

Description: Sequence consists of medium-light-gray plastic underclay (0.7 foot, or 0.2 m), carbonaceous claystone (0.5 foot, or 15.2 cm), then 0.2 inch (0.51 cm) of coal, and 9.7 feet (3.0 m) of alternating medium- to dark-gray shales and thin-bedded claystones. The upper foot (0.3 m) of sampled material is limy and underlies 3 feet (0.9 m) of limestone. Shaly siltstones lie stratigraphically below the sampled interval.

Attitude of bedding: Horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 11.1 feet (3.4 m) of material

Chemical analysis:

	%
SiO ₂	54.9
TiO ₂	1.0
Al ₂ O ₃	18.7
Fe ₂ O ₃	2.4
FeO	4.0
MnO	0.03
MgO	1.2
CaO	0.52
Na ₂ O	0.22
K ₂ O	2.8
P ₂ O ₅	0.12
S (total)	1.1
C (org.)	2.9
CO ₂	0.04
H ₂ O ⁻	2.2
H ₂ O ⁺	8.1
Volatiles (excl. H ₂ O, CO ₂)	3.1

Mineralogy (X-ray):

	%
Quartz	23
Mica	57
Kaolinite	18
Chlorite- vermiculite	0
Feldspar	1
Montmorillonite	1
Calcite	0

Raw properties:

Water of plasticity (%):	23.3
Drying shrinkage (%):	2.5
Workability:	Plastic
Dry strength:	Fair
Drying defects:	None
pH:	8.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Orange tan	3	5.0	23.9	38.1	1.59
982						
1900	Dark tan	3	7.5	19.4	33.6	1.73
1038						
2000	Red tan	4	10.0	8.7	17.9	2.05
1093						
2100	Red brown	5	12.5	4.1	8.7	2.14
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2000°F.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe.

ALLEGHENY COUNTY Moon Twp. Ambridge quad.Sample number **16-C-9**

Location: Exposure along highway on southwest side of Ohio River, about 1300 feet (400 m) south-southeast of Stoops Ferry and 1600 feet (490 m) north-northwest of the Sewickley Bridge.

Latitude: 40°32'02"N

Longitude: 80°11'35"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Grayish-black shales of the Brush Creek shale horizon underlie a massive-bedded dark-gray silty limestone. The shales contain siderite nodules ranging in size from 1 to 3 inches (2.5 to 7.6 cm) in their long dimension. Interval of shale exposed measures 14 feet (4 m).

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 9 stratigraphic feet (2.7 m)

Chemical analysis:

	%
SiO ₂	57.3
TiO ₂	0.93
Al ₂ O ₃	18.1
Fe ₂ O ₃	2.9
FeO	2.2
MnO	0.04
MgO	1.9
CaO	3.0
Na ₂ O	0.15
K ₂ O	3.3
P ₂ O ₅	0.12
S (total)	1.3
C (org.)	0.76
CO ₂	0.05
H ₂ O ⁻	1.9
H ₂ O ⁺	5.3
Volatiles (excl. H ₂ O, CO ₂)	2.0

Mineralogy (X-ray):

	%
Quartz	28
Mica	52
Kaolinite	13
Chlorite- vermiculite	1
Feldspar	5
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%):	17.6
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	9.2

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	13.1	24.9	1.90
982						
1900	Light brown	4	10.0	8.9	18.2	2.06
1038						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2000	Light brown	4	10.0	4.8	10.7	2.22
1093						
2100	Red brown	4	10.0	2.7	6.0	2.23
1149						
2200	--	--	--	--	--	--
1204						
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Positive

Remarks: Fair color (1800°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.60	99.8	17.1	No expansion.
1038				
2000	1.51	94.1	14.9	No expansion.
1093				
2100	1.15	71.8	19.1	Fair pore structure.
1149				
2200	0.67	42.0	32.9	Overbloomed; large pores.
1204				
2300	--	--	--	--
1260				

Recommendations: Promising raw material for lightweight aggregate; recommend rotary kiln test to evaluate further.

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	23.1	23.1
-1.9 cm	+1.3 cm		

Raw material:

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-1/2"	+3/8"	12.8	35.9
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	34.4	70.3
-.95 cm			
-4 mesh	+8 mesh	29.7	100.0
-8 mesh	PAN	--	--

Fragment shape: Tabular and angular

Crushing loss (-4 mesh): 29.7

Firing data:

Size range of feed: -3/4" (1.9 cm) +4 mesh

Pour weight of feed (lb/ft³): 90.0 Bloating temperature (°F): 2100
 (kg/m³): 1441.8 (°C): 1149

Logging temperature, nodules sticking together (°F): 2140
 (°C): 1171

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designa- tion</i>	<i>3/4" (1.9 cm)</i>	<i>1/2" (1.3 cm)</i>	<i>3/8" (.95 cm)</i>	<i>No. 4</i>	<i>No. 8</i>	<i>No. 16</i>	<i>No. 50</i>	<i>No. 100</i>
Fine	--	--	--	--	100.0	48.6	15.7	10.5
Coarse	100.0	87.5	66.5	16.8	10.5	--	--	--

Fine: 46.0

Coarse: 42.0

Potential uses: Grade SW building brick; Type FBA facing brick; lightweight aggregate.

*ASTM designation C311-59T

ALLEGHENY COUNTY Aleppo Twp. Ambridge quad.Sample number **16-C-10**

Location: Exposure on the north side of Pa. Route 65, about 4500 feet (1370 m) east of Haysville.

Latitude: 40°31'18"N**Longitude:** 80°08'39"W**Geologic unit:** Glenshaw Formation, Conemaugh Group

Description: Greenish-gray to dark-greenish-gray, interbedded fissile shales, thin-bedded silty shales, and shaly siltstones occur over a stratigraphic interval of 12 feet (4 m). Rocks break down into predominantly angular, platy fragments. Slight effervescence with acid.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Moderate to severe

Sampled interval: Channel through 12 stratigraphic feet (4 m)

Chemical analysis:

	%
SiO ₂	56.3
TiO ₂	1.0
Al ₂ O ₃	18.6
Fe ₂ O ₃	4.0
FeO	4.0
MnO	0.13
MgO	2.3
CaO	0.79
Na ₂ O	0.77
K ₂ O	2.9
P ₂ O ₅	0.17
S (total)	0.24
C (org.)	1.6
CO ₂	0.45
H ₂ O ⁻	0.89
H ₂ O ⁺	5.8
Volatiles (excl. H ₂ O, CO ₂)	0.80

Mineralogy (X-ray):

	%
Quartz	27
Mica	47
Kaolinite	7
Chlorite- vermiculite	11
Feldspar	8
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	20.3
Drying shrinkage (%):	2.5
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	9.2

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Dark tan	3	2.5	19.0	32.4	1.71
982						
1900	Dark tan	3	5.0	16.5	29.8	1.80
1038						
2000	Dark tan	4	7.5	14.4	28.1	1.94
1093						
2100	Red brown	4	10.0	2.8	6.3	2.27
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Good color (2100°F). Abrupt vitrification (2000-2100°F). May be limy.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)	% Absorb.	Remarks
1800	--	--	--
982			

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1900	2.06	128.4	6.3	No expansion.
1038				
2000	1.66	103.6	13.6	No expansion.
1093				
2100	1.09	68.0	20.7	Good pore structure.
1149				
2200	0.98	61.4	16.2	Good pore structure.
1204				
2300	--	--	--	--
1260				

Recommendations: Promising raw material for lightweight aggregate; rotary kiln test recommended to evaluate further.

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1 inch (2.5 cm) in diameter Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1"x1" (2.5x2.5 cm) rod

Pour weight of feed (lb/ft³): 88.0 Bloating temperature (°F): 2050
(kg/m³): 1409.8 (°C): 1121

Logging temperature, nodules sticking together (°F): 2090
(°C): 1143

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designation</i>	<i>3/4"</i> (1.9 cm)	<i>1/2"</i> (1.3 cm)	<i>3/8"</i> (.95 cm)	<i>No.</i> 4	<i>No.</i> 8	<i>No.</i> 16	<i>No.</i> 50	<i>No.</i> 100
Fine	--	--	--	--	100.0	55.0	21.6	14.1
Coarse	100.0	98.1	69.6	67.0	48.9	--	--	--

Fine: 45.0

Coarse: 42.0

ASTM designation C311-59T

Remarks: Promising raw material for lightweight aggregate; may be necessary to pelletize.

Potential uses: Grade MW building brick; Type FBA facing brick; lightweight aggregate.

ALLEGHENY COUNTY Ross Twp. Pittsburgh West quad.

Sample number 17-B-2A

Location: Exposure near the base of a cliff on the northeast side of the Penn-Central Railroad tracks, about 3400 feet (1040 m) north-northwest of where the McKees Rocks Bridge passes over the railroad.

Latitude: 40°29'07"N

Longitude: 80°03'11"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Olive-black, brownish-black, and grayish-black shales underlie a sandstone horizon for a stratigraphic distance of 10 feet (3 m). The shale is relatively soft and breaks easily into platy, angular fragments. No effervescence with acid. Iron staining occurs along fractures and bedding planes. Sample 17-B-2B was collected immediately below this sample.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 10 stratigraphic feet (3 m)

Chemical analysis:

	%
SiO ₂	57.0
TiO ₂	1.0
Al ₂ O ₃	19.6
Fe ₂ O ₃	4.3
FeO	3.2
MnO	0.07
MgO	1.9
CaO	0.62
Na ₂ O	0.32
K ₂ O	3.3
P ₂ O ₅	0.26
S (total)	0.45
C (org.)	1.1
CO ₂	0.07
H ₂ O ⁻	1.2
H ₂ O ⁺	6.0

Mineralogy (X-ray):

	%
Quartz	23
Mica	57
Kaolinite	9
Chlorite-vermiculite	5
Feldspar	3
Montmorillonite	3
Calcite	0

Raw properties:

Water of plasticity (%):	21.0
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	6.8

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	17.4	30.6	1.76
982						
1900	Tan	3	5.0	14.3	26.6	1.87
1038						
2000	Tan	4	7.5	7.9	16.7	2.11
1093						
2100	Red brown	4	10.0	3.1	7.1	2.27
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Good color (2100°F).

Bloating tests (quick-firing):

Crushing characteristics: Tabular and angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
800	--	--	--	--
982				
900	1.88	117.3	13.4	No expansion.
1038				
2000	1.51	94.2	14.5	No expansion.
1093				
2100	1.37	85.5	17.1	Mixed bloated and non-bloated.
1149				
2200	0.71	44.3	13.4	Overbloated and sticky.
1204				
300	--	--	--	--
260				

Remarks: Not suitable for lightweight aggregate because of mixture of bloating and nonbloating materials.

Potential uses: Grade SW building brick; Type FBA facing brick; Type H floor brick.

ALLEGHENY COUNTY

Ross Twp. Pittsburgh West quad.

Sample number 17-B-2B

Location: Exposure near the base of a cliff on the northeast side of the Penn Central Railroad tracks, about 3400 feet (1040 m) north-northwest of where the McKees Rocks Bridge passes over the railroad.

Latitude: 40°29'07"N

Longitude: 80°03'11"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Greenish-gray to olive-gray, thin-bedded silty shales occur over a stratigraphic interval of 10 feet (3 m) below sample 17-B-2A. Breaks down into papery and platy fragments. No effervescence with acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):	
	%		%
SiO ₂	57.9	Quartz	27
TiO ₂	0.89	Mica	60
Al ₂ O ₃	19.6	Kaolinite	0
Fe ₂ O ₃	4.4	Chlorite-	
FeO	3.4	vermiculite	11
MnO	0.09	Feldspar	2
MgO	1.9	Montmorillonite	0
CaO	0.42	Calcite	0
Na ₂ O	0.28		
K ₂ O	3.5		
P ₂ O ₅	0.2		
S (total)	0.16	Raw properties: Water of plasticity (%): 20.4 Drying shrinkage (%): 2.5 Workability: Plastic Dry strength: Good Drying defects: None pH: 6.3	
C (org.)	1.0		
CO ₂	0.03		
H ₂ O ⁻	0.86		
H ₂ O ⁺	5.7		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	19.7	32.7	1.71
982						
1900	Tan	3	5.0	16.8	30.1	1.79
1038						
2000	Light brown	4	7.5	10.6	21.3	2.01
1093						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2100	Red brown	4	10.0	4.5	10.1	2.23
1149						
2200	Dark brown	4	10.0	0.1	0.2	2.26
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color at 2100°F.

Potential uses: Grade MW building brick; Type FBS facing brick; sewer pipe; liner plates.

ALLEGHENY COUNTY Pittsburgh (City of) Pittsburgh West quad.

Sample number 17-B-3A

Location: Exposure east of the north portal of the Fort Pitt Tunnel in the Mt. Washington area.

Latitude: 40°25'57"N

Longitude: 80°00'15"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Olive-gray to olive-black shale of the Birmingham shale horizon occurs directly above the Ames limestone for a stratigraphic interval of 10 feet (3 m). Shale breaks down into angular, hackly fragments; about 10 to 15 percent of the fragments are iron-stained yellowish brown to moderate brown. No effervescence with acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel through 10 stratigraphic feet (3 m)

Chemical analysis:

	%
SiO ₂	57.5
TiO ₂	1.0
Al ₂ O ₃	20.8
Fe ₂ O ₃	4.5
FeO	2.8
MnO	0.02
MgO	1.7
CaO	0.33

Mineralogy (X-ray):

	%
Quartz	28
Mica	56
Kaolinite	7
Chlorite- vermiculite	8
Feldspar	1
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.26
K ₂ O	3.3
P ₂ O ₅	0.09
S (total)	0.04
C (org.)	0.17
CO ₂	0.02
H ₂ O ⁻	1.7
H ₂ O ⁺	6.0

Raw properties:

Water of plasticity (%): 18.9
Drying shrinkage (%): 5.0
Workability: Plastic
Dry strength: Good
Drying defects: None
pH: 7.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	14.9	27.4	1.84
982						
1900	Tan	3	5.0	11.8	23.1	1.96
1038						
2000	Light brown	4	7.5	6.2	13.5	2.19
1093						
2100	Red brown	5	10.0	2.5	5.9	2.33
1149						
2200	Dark brown	6	10.0	3.4	7.9	2.34
1204						
2300	--	--	Expanded	--	--	-
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Good colors at 1800° and 2100°F.

Potential uses: Grade MW building brick; Type FBS facing brick; Type H floor brick.

ALLEGHENY COUNTY Pittsburgh (City of) Pittsburgh West quad
Sample number 17-B-3B

Location: Exposure east of the north portal of the Fort Pitt Tunnel in the Mt Washington area.

Latitude: 40°25'57"N Longitude: 80°00'15"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Olive-black, interbedded shales and silty shales of the Birmingham shale horizon occur from 10 to 20 feet (3 to 6 m) above the Ames limestone horizon. Several thin bands of siderite, up to 3/8 inch (1.0 cm) thick, occur in the lower part of the sampled interval. Shales and silty shales break down into angular but very platy fragments. Iron staining limited to 10 to 15 percent of fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 10 stratigraphic feet (3 m)

Chemical analysis:

	%
SiO ₂	55.9
TiO ₂	0.88
Al ₂ O ₃	19.7
Fe ₂ O ₃	4.8
FeO	3.9
MnO	0.19
MgO	2.1
CaO	0.70
Na ₂ O	0.66
K ₂ O	3.1
P ₂ O ₅	0.22
S (total)	0.09
C (org.)	1.4
CO ₂	0.07
H ₂ O ⁻	1.1
H ₂ O ⁺	6.0

Mineralogy (X-ray):

	%
Quartz	21
Mica	50
Kaolinite	16
Chlorite- vermiculite	8
Feldspar	5
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	23.6
Drying shrinkage (%):	2.5
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	7.9

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	22.0	36.0	1.63
982						
1900	Tan	3	5.0	17.8	31.4	1.77
1038						
2000	Light brown	4	10.0	10.8	21.6	2.00
1093						
2100	Red brown	4	10.0	4.8	10.4	2.19
1149						
2200	Dark brown	6	12.5	2.2	4.8	2.17
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Good color (2100°F).

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.47	91.7	10.1	No expansion.
1038				
2000	1.39	86.7	11.7	Laminar expansion.
1093				
2100	0.69	43.1	17.8	Very good pore structure.
1149				
2200	0.58	36.2	18.4	Fair pore structure.
1204				
2300	--	--	--	--
1260				

Recommendations: Promising raw material for lightweight aggregate; testing in the rotary kiln recommended for further evaluation.

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1 inch (2.5 cm) in diameter

Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1"x1" (2.5x2.5 cm) rod

Pour weight of feed (lb/ft³): 78.0 Bloating temperature (°F): 2060
(kg/m³): 1249.6 (°C): 1127Logging temperature, nodules sticking together (°F): 2160
(°C): 1182

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

Size designa- tion	3/4" (1.9 cm)	1/2" (1.3 cm)	3/8" (.95 cm)	No. 4	No. 8	No. 16	No. 50	No. 100
Fine	--	--	--	--	100.0	48.6	18.6	13.4
Coarse	100.0	85.6	69.3	16.2	9.7	--	--	--

Fine: 47.0

Coarse: 40.0

Remarks: Promising material for lightweight aggregate.**Potential uses:** Grade SW building brick; Type FBA facing brick; lightweight aggregate.

*ASTM designation C311-59T

ALLEGHENY COUNTY Glassport Twp. Glassport quad.Sample number **27-C-9****Location:** Apex Coal Company stripping operation, located about 4000 feet (1220 m) southeast of the center of Glassport.**Latitude:** 40°18'58"N**Longitude:** 79°52'46"W**Geologic unit:** Pittsburgh Formation, Monongahela Group**Description:** Varicolored thin-bedded shales occur above the Redstone coal. The shales are dark gray in the basal portion of the interval, grading upward into greenish-gray colors. Beds commonly 1-1/2 inches (3.8 cm) or less in thickness. Orange-brown iron staining is common. The shale is broken easily, due to the moderate to severe degree of weathering.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Moderate to severe**Sampled interval:** Channel sample from 0 to 10 stratigraphic feet (0 to 3 m) above the Redstone coal

Chemical analysis:

	%
SiO ₂	51.7
TiO ₂	0.88
Al ₂ O ₃	21.4
Fe ₂ O ₃	10.2
FeO	0.8
MnO	0.07
MgO	1.4
CaO	0.35
Na ₂ O	0.36
K ₂ O	3.4
P ₂ O ₅	0.24
S (total)	0.11
C (org.)	0.54
CO ₂	0.02
H ₂ O ⁻	2.0
H ₂ O ⁺	7.2

Mineralogy (X-ray):

	%
Quartz	13
Mica	67
Kaolinite	12
Chlorite- vermiculite	7
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	25.3
Drying shrinkage (%):	2.5
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	7.2

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	19.0	34.4	1.81
982						
1900	Dark tan	4	10.0	11.0	22.4	2.02
1038						
2000	Light brown	4	10.0	4.2	9.8	2.33
1093						
2100	Red brown	6	15.0	0.7	1.6	2.45
1149						
2200	Dark brown	7	15.0	0.1	0.2	2.40
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color at 2100°F.

Potential uses: Grade SW building brick; Type L floor brick.

ALLEGHENY COUNTY Glassport Twp. Glassport quad.

Sample number 27-C-10A

Location: Cliff exposure on the northeast side of the Monongahela River along the Glassport-Elizabeth Road, about 3500 feet (1070 m) southeast of the athletic field in Glassport.

Latitude: 40°18'48"N

Longitude: 79°52'49"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Dark-gray to grayish-black fissile shale of the Birmingham shale horizon occurs from 6 to 15 feet (1.8 to 4.6 m) above the Ames limestone. Breaks down into papery fragments. No effervescence with HCl.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample from 6 to 15 feet (1.8 to 4.6 m) above Ames limestone

Chemical analysis:

	%
SiO ₂	56.0
TiO ₂	0.84
Al ₂ O ₃	20.3
Fe ₂ O ₃	2.8
FeO	5.3
MnO	0.05
MgO	2.3
CaO	0.51
Na ₂ O	0.65
K ₂ O	2.9
P ₂ O ₅	0.22
S (total)	0.06
C (org.)	0.82
CO ₂	0.67
H ₂ O ⁻	1.0
H ₂ O ⁺	6.5

Mineralogy (X-ray):

	%
Quartz	19
Mica	63
Kaolinite	2
Chlorite-vermiculite	10
Feldspar	6
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 15.7
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 8.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	13.0	25.6	1.96
982						
1900	Salmon	3	5.0	9.9	20.7	2.08
1038						
2000	Light brown	4	10.0	6.0	13.3	2.24
1093						
2100	Red brown	4	10.0	4.1	9.4	2.30
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: NA

Bloating test: Negative

Remarks: Good color at 2100°F.

Potential uses: Grade MW building brick; Type FBA facing brick.

ALLEGHENY COUNTY Glassport Twp. Glassport quad.

Sample number 27-C-10B

Location: Cliff exposure on the northeast side of the Monongahela River along the Glassport-Elizabeth Road, about 3500 feet (1070 m) southeast of the athletic field in Glassport.

Latitude: 40°18'48"N

Longitude: 79°52'49"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Greenish-gray thin-bedded laminated shaly siltstone interval occurs from 15 to 30 feet (5 to 9 m) above the Ames limestone. Breaks down into platy fragments commonly less than 3 inches (7.6 cm) in their long dimension. No effervescence with acid. Twelve feet (4 m) of massive-bedded siltstones are stratigraphically above the sampled interval. Interval is stratigraphically within the Birmingham shale unit.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Composite representing 15 feet (5 m) of shaly siltstone

Chemical analysis:		Mineralogy (X-ray):	
	%		%
SiO ₂	58.7	Quartz	24
TiO ₂	0.93	Mica	61
Al ₂ O ₃	19.0	Kaolinite	2
Fe ₂ O ₃	2.2	Chlorite-	
FeO	5.6	vermiculite	9
MnO	0.14	Feldspar	4
MgO	2.2	Montmorillonite	0
CaO	0.37	Calcite	0
Na ₂ O	0.77		
K ₂ O	2.9		
P ₂ O ₅	0.17	Raw properties:	
S (total)	0.06	Water of plasticity (%):	17.7
C (org.)	0.44	Drying shrinkage (%):	2.5
CO ₂	0.05	Workability:	Short
H ₂ O ⁻	0.7	Dry strength:	Fair
H ₂ O ⁺	5.7	Drying defects:	None
		pH:	8.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	17.2	30.1	1.75
982						
1900	Salmon	4	5.0	13.3	24.4	1.83
1038						
2000	Light brown	4	5.0	11.8	24.0	2.03
1093						
2100	Red brown	4	7.5	3.3	7.5	2.30
1149						
2200	Dark brown	6	10.0	0.1	0.1	2.20
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Good color (2100°F).

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.81	113.2	6.8	No expansion.
1038				
2000	1.27	79.2	9.4	Laminar expansion.
1093				
2100	1.00	62.4	7.8	Good pore structure.
1149				
2200	0.66	40.9	11.8	Fair pore structure; sticky.
1204				
2300	--	--	--	--
1260				

Recommendations: Promising raw material for lightweight aggregate; further evaluation by rotary kiln test is recommended.

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1/2 inch
(1.3 cm) in diameter

Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1/2"x1" (1.3x2.5 cm) rod

Pour weight of feed (lb/ft³): 86.0
(kg/m³): 1377.7

Bloating temperature (°F): 2100
(°C): 1149

Logging temperature, nodules sticking together (°F): 2140
(°C): 1171

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designa- tion</i>	<i>3/4" (1.9 cm)</i>	<i>1/2" (1.3 cm)</i>	<i>3/8" (.95 cm)</i>	<i>No. 4</i>	<i>No. 8</i>	<i>No. 16</i>	<i>No. 50</i>	<i>No. 100</i>
Fine	--	--	--	--	100.0	43.0	14.5	9.8
Coarse	100.0	75.0	56.8	31.8	25.0	--	--	--

Fine: 56.0

Coarse: 37.0

Remarks: Promising raw material for lightweight aggregate (may be necessary to pelletize).

Potential uses: Grade SW building brick; lightweight aggregate.

*ASTM designation C311-59T

ALLEGHENY COUNTY Glassport Twp. Glassport quad.

Sample number **27-C-10C**

Location: Cliff exposure on the northeast side of the Monongahela River along the Glassport-Elizabeth Road, about 3500 feet (1070 m) southeast of the athletic field in Glassport.

Latitude: 40°18'48"N

Longitude: 79°52'49"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Pale-red, brownish-red, and greenish-gray claystone interval from 42 to 55 feet (13 to 17 m) above the Ames limestone. Breaks down into irregularly shaped fragments; development of conchoidal fractures common. Interval is probably within the Birmingham shale or Wellersburg clay unit.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Composite representing interval from 42 to 55 feet (13 to 17 m) above the Ames limestone

Chemical analysis:

	%
SiO ₂	56.3
TiO ₂	0.91
Al ₂ O ₃	19.7
Fe ₂ O ₃	5.2
FeO	2.9
MnO	0.11
MgO	2.4
CaO	0.68
Na ₂ O	0.57
K ₂ O	3.2
P ₂ O ₅	0.17
S (total)	0.04
C (org.)	0.16
CO ₂	0.05
H ₂ O ⁻	1.6
H ₂ O ⁺	6.2

Mineralogy (X-ray):

	%
Quartz	22
Mica	54
Kaolinite	11
Chlorite-vermiculite	9
Feldspar	3
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%):	17.0
Drying shrinkage (%):	2.5
Workability:	Short
Dry strength:	Good
Drying defects:	None
pH:	8.7

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	12.3	23.8	1.94
982						
1900	Light brown	4	7.5	8.2	17.4	2.12
1038						
2000	Light brown	4	10.0	2.7	6.4	2.34
1093						
2100	Red brown	5	12.5	0.1	0.3	2.42
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color at 2100°F.

Potential uses: Grade SW building brick; Type L floor brick.

ALLEGHENY COUNTY Jefferson Twp. Glassport quad.

Sample number **27-C-11A**

Location: Strip pit operated by Fred Fiore, located about 6000 feet (1830 m) east-northeast of the village of Cochrans Mill.

Latitude: 40°17'44"N

Longitude: 79°56'28"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Dark-greenish-gray, greenish-black to olive-black, fissile shales occur from 0 to 5 feet (0 to 1.5 m) above the Redstone coal. Shale is soft and is easily broken into angular, papery, and platy fragments. Slight effervescence with acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel sample through shale

Chemical analysis:

	%
SiO ₂	51.8
TiO ₂	0.84
Al ₂ O ₃	22.9
Fe ₂ O ₃	2.1
FeO	5.5
MnO	0.10
MgO	1.8
CaO	0.60
Na ₂ O	0.37
K ₂ O	3.3
P ₂ O ₅	0.16
S (total)	0.28
C (org.)	1.1
CO ₂	1.8
H ₂ O ⁻	1.3
H ₂ O ⁺	6.8

Mineralogy (X-ray):

	%
Quartz	20
Mica	53
Kaolinite	16
Chlorite-vermiculite	7
Feldspar	4
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	14.5
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	8.7

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	15.7	29.8	1.91
982						
1900	Salmon	4	7.5	11.7	24.4	2.09
1038						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2000	Light brown	4	7.5	8.3	18.3	2.22
1093						
2100	Medium brown	4	10.0	5.7	13.2	2.32
1149						
2200	Dark brown	5	10.0	3.3	7.9	2.40
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent:ND

Bloating test:Negative

Remarks: Poor color.

Potential uses: Grade SW building brick.

ALLEGHENY COUNTY Jefferson Twp. Glassport quad.

Sample number 27-C-11B

Location: Strip pit operated by Fred Fiore, located about 6000 feet (1830 m) east-northeast of the village of Cochrans Mill.

Latitude:40°17'44"N

Longitude:79°56'28"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Medium-bluish-gray to dark-greenish-gray, thin- to medium-bedded, micaceous claystones occur from 5 to 21 feet (1.5 to 6 m) above the Redstone coal. Beds range from 1 inch (2.5 cm) up to about 1 foot (0.3 m) in thickness, but average about 3 to 6 inches (7.6 to 15.2 cm). Breaks down into angular, platy to slabby fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Composite sample representing claystone interval from 5 to 15 feet (1.5 to 4 m) above the Redstone coal

Chemical analysis:		Mineralogy (X-ray):	
	%		%
SiO ₂	56.5	Quartz	24
TiO ₂	1.0	Mica	47
Al ₂ O ₃	20.0	Kaolinite	11
Fe ₂ O ₃	2.5	Chlorite-	
FeO	4.9	vermiculite	12
MnO	0.12	Feldspar	6
MgO	2.2	Montmorillonite	0
CaO	0.50	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.72
K ₂ O	3.4
P ₂ O ₅	0.12
S (total)	0.06
C (org.)	0.49
CO ₂	1.5
H ₂ O ⁻	0.63
H ₂ O ⁺	6.0

Raw properties:

Water of plasticity (%): 18.7
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 8.9

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	2.5	16.2	28.8	1.79
982						
1900	Salmon	3	5.0	14.7	24.6	1.86
1038						
2000	Light brown	4	5.0	10.3	20.7	2.02
1093						
2100	Red brown	4	10.0	4.3	9.6	2.26
1149						
2200	Dark brown	4	10.0	0.1	0.3	2.31
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2100°F.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe.

ALLEGHENY COUNTY Jefferson Twp. Glassport quad.Sample number **27-C-11C**

Location: Strip pit operated by Fred Fiore located about 6000 feet (1830 m) east-northeast of the village of Cochran's Mill.

Latitude: 40°17'44"N**Longitude:** 79°56'28"W**Geologic unit:** Pittsburgh Formation, Monongahela Group

Description: Medium-dark-gray, dark-gray, and olive-black, massive-bedded claystones occur from 21 to 39 feet (6 to 12 m) above the Redstone coal. Conchoidal fracturing is common. Claystone breaks down into hackly fragments. Dark-yellow-orange to light-brown iron staining is present along fractures.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Composite representing the claystone

Chemical analysis:

	%
SiO ₂	50.1
TiO ₂	0.81
Al ₂ O ₃	17.4
Fe ₂ O ₃	3.4
FeO	3.1
MnO	0.16
MgO	3.0
CaO	4.2
Na ₂ O	0.22
K ₂ O	3.4
P ₂ O ₅	0.21
S (total)	0.86
C (org.)	0.23
CO ₂	5.3
H ₂ O ⁻	2.2
H ₂ O ⁺	5.9

Mineralogy (X-ray):

	%
Quartz	16
Mica	76
Kaolinite	0
Chlorite-	
vermiculite	3
Feldspar	4
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%):	15.6
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Good
Drying defects:	None
pH:	8.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Dark tan	4	10.0	9.3	19.1	2.06
982						
1900	Light brown	4	10.0	7.4	15.7	2.11
1038						
2000	Light brown	4	10.0	7.2	15.5	2.14
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (1800°F). Abrupt vitrification (2000-2100°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.57	97.7	11.4	No expansion.
1038				
2000	1.40	87.4	7.9	No expansion.
1093				
2100	1.15	71.7	5.2	Good pore structure.
1149				
2200	1.01	62.8	13.6	Good pore structure.
1204				
2300	--	--	--	--
1260				

Recommendations: Material should be evaluated further in the rotary kiln for potential as source for lightweight aggregate.

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	24.1	24.1
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	16.4	40.5
-1.3 cm	+95 cm		
-3/8"	+4 mesh	55.0	95.5
-.95 cm			
-4 mesh	+8 mesh	2.2	97.7
-8 mesh	PAN	2.3	100.0

Fragment shape: Angular and tabular Crushing loss (-4 mesh): 4.5 percent

Firing data:

Size range of feed: -3/4" (1.9 cm) +4 mesh

Pour weight of feed (lb/ft³): 82.0 Bloating temperature (°F): 2110
(kg/m³): 1313.6 (°C): 1154

Logging temperature, nodules sticking together (°F): 2260
(°C): 1238

Firing data:

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designa- tion</i>	<i>3/4'' (1.9 cm)</i>	<i>1/2'' (1.3 cm)</i>	<i>3/8'' (.95 cm)</i>	<i>No. 4</i>	<i>No. 8</i>	<i>No. 16</i>	<i>No. 50</i>	<i>No. 100</i>
Fine	Not done							
Coarse								

Fine: --

Coarse: 61.0

Remarks: Not suitable for use as lightweight aggregate due to mixture of bloating and nonbloating materials.**Potential uses:** Grade SW building brick; Type FBA facing brick.

*ASTM designation C311-59T

ALLEGHENY COUNTY Jefferson Twp. Glassport quad.Sample number **27-C-11D****Location:** Strip pit operated by Fred Fiore located about 6000 feet (1830 m) east-northeast of the village of Cochrans Mill.**Latitude:** 40°17'44''N**Longitude:** 79°56'28''W**Geologic unit:** Pittsburgh Formation, Monongahela Group**Description:** Varicolored thin-bedded silty shales occur from 39 to 44 feet (12 to 13 m) above the Redstone coal. Least weathered shales are predominantly olive black, light olive gray, and grayish olive. Severely weathered shales are medium to pale brown. Fragments are angular and platy. Heavy iron staining is present along fractures.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Severe**Sampled interval:** Channel sample of silty shales from 39 through 44 feet (12 to 13 m) above Redstone coal**Chemical analysis:****Mineralogy (X-ray):**

	%		%
SiO ₂	53.1	Quartz	20
TiO ₂	0.86	Mica	68
Al ₂ O ₃	20.1	Kaolinite	0
Fe ₂ O ₃	7.6	Chlorite-	
FeO	0.88	vermiculite	2
MnO	0.04	Feldspar	3
MgO	1.9	Montmorillonite	7
CaO	0.65	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.48
K ₂ O	4.6
P ₂ O ₅	0.25
S (total)	0.07
C (org.)	0.69
CO ₂	0.12
H ₂ O ⁻	2.8
H ₂ O ⁺	6.7

Raw properties:

Water of plasticity (%):	22.5
Drying shrinkage (%):	2.5
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	8.0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Orange tan	3	10.0	13.6	26.1	1.92
982						
1900	Orange tan	4	10.0	9.2	19.1	2.08
1038						
2000	Light brown	4	10.0	4.7	10.6	2.25
1093						
2100	Red brown	6	15.0	1.7	4.1	2.35
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Marginal colors.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.65	102.9	8.1	No expansion.
1038				
2000	1.48	92.4	5.8	Laminar expansion.
1093				
2100	0.89	55.5	6.1	Fair pore structure.
1149				
2200	0.63	39.3	14.7	Overbloomed; large pores.
1204				
2300	--	--	--	--
1260				

Recommendations: Short firing range; evaluate further by rotary kiln testing.

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1 inch (2.5 cm) in diameter Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1"x1" (2.5x2.5 cm) rod

Pour weight of feed (lb/ft³): 76.0 Bloating temperature (°F): 2140
(kg/m³): 1217.5 (°C): 1171

Logging temperature, nodules sticking together (°F): 2160
(°C): 1182

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designa- tion</i>	<i>3/4" (1.9 cm)</i>	<i>1/2" (1.3 cm)</i>	<i>3/8" (.95 cm)</i>	<i>No. 4</i>	<i>No. 8</i>	<i>No. 16</i>	<i>No. 50</i>	<i>No. 100</i>
Fine	--	--	--	--	100.0	53.7	16.9	11.3
Coarse	100.0	81.4	69.5	36.0	26.1	--	--	--

Fine: 39.0

Coarse: 37.0

Remarks: Promising raw material for lightweight aggregate (may be necessary to pelletize).

Potential uses: Grade SW building brick; lightweight aggregate.

*ASTM designation C311-59T

ALLEGHENY COUNTY Forward Twp. Monongahela quad.

Sample number **28-A-4A**

Location: Pittsburgh Coal Company core drill hole F332 on Sam Warren property, located about 2000 feet (610 m) southwest of Hilddale.

Latitude: 40°14'34"N

Longitude: 79°53'14"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Gray shales containing an occasional light-gray thin bed of silty shale represent this interval from the Birmingham shale unit within the Casselman Formation.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core representing depths from 333 to 340 feet (101 to 104 m)

Chemical analysis:

	%
SiO ₂	66.2
TiO ₂	1.0
Al ₂ O ₃	14.6
Fe ₂ O ₃	2.0
FeO	4.0
MnO	0.10
MgO	2.1
CaO	1.2
Na ₂ O	1.2
K ₂ O	1.7
P ₂ O ₅	0.16
S (total)	0.40
C (org.)	0.10
CO ₂	0.95
H ₂ O ⁻	0.55
H ₂ O ⁺	4.2

Mineralogy (X-ray):

	%
Quartz	36
Mica	34
Kaolinite	10
Chlorite-	
vermiculite	11
Feldspar	9
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	16.3
Drying shrinkage (%):	2.5
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	8.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	2.5	16.0	29.0	1.81
982						
1900	Orange tan	2	2.5	14.9	27.7	1.86
1038						
2000	Orange tan	3	2.5	13.2	25.3	1.92
1093						
2100	Dark red	4	10.0	4.9	10.9	2.20
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color at 2100°F; slightly effervescent with HCl.

Potential uses: Grade MW building brick; drain tile.

ALLEGHENY COUNTY Forward Twp. Monongahela quad.Sample number **28-A-4B****Location:** Pittsburgh Coal Company core drill hole F332 on Sam Warren property, located about 2000 feet (610 m) southwest of Hilldale.**Latitude:** 40°14'34"N**Longitude:** 79°53'14"W**Geologic unit:** Casselman Formation, Conemaugh Group**Description:** Gray and dark-green-gray shales containing an occasional light-gray thin bed of siltstone or limy veinlet represent this sample from the Birmingham shale unit within the Casselman Formation.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Entire core from depths of 340 to 345 feet (104 to 105 m)**Chemical analysis:**

	%
SiO ₂	58.7
TiO ₂	0.82
Al ₂ O ₃	12.4
Fe ₂ O ₃	2.1
FeO	4.6
MnO	0.22
MgO	1.8
CaO	6.5
Na ₂ O	1.1
K ₂ O	1.5
P ₂ O ₅	0.15
S (total)	0.30
C (org.)	0.10
CO ₂	5.9
H ₂ O ⁻	0.38
H ₂ O ⁺	3.9

Mineralogy (X-ray):

	%
Quartz	34
Mica	41
Kaolinite	2
Chlorite-vermiculite	8
Feldspar	8
Montmorillonite	3
Calcite	4

Raw properties:

Water of plasticity (%): 17.2
Drying shrinkage (%): 2.5
Workability: Short
Dry strength: Poor
Drying defects: None
pH: 8.0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light brown	2	2.5	20.2	34.9	1.73
982						
1900	Light brown	2	2.5	18.2	32.3	1.77
1038						
2000	Light brown	2	2.5	18.2	32.2	1.77
1093						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2100	Dark brown	4	5.0	10.0	20.4	2.04
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Poor color. Abrupt vitrification (2000-2100°F). Slightly effervescent with HCl.

Potential uses: Grade SW building brick; drain tile.

ALLEGHENY COUNTY Forward Twp. Monongahela quad.

Sample number 28-A-4C

Location: Pittsburgh Coal Company core drill hole F332 on the Sam Warren property, located about 2000 feet (610 m) southwest of Hilldale.

Latitude: 40°14'34"N

Longitude: 79°53'14"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Dark-gray and dark-green-gray shales from the Birmingham shale unit within the Casselman Formation represent this sample.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core from depths of 345 to 354.5 feet (105 to 108.1 m)

Chemical analysis:

	%
SiO ₂	60.6
TiO ₂	0.94
Al ₂ O ₃	16.1
Fe ₂ O ₃	1.4
FeO	5.6
MnO	0.13
MgO	2.1
CaO	1.4
Na ₂ O	1.0
K ₂ O	3.2
P ₂ O ₅	0.20
S (total)	0.17
C (org.)	< 0.1
CO ₂	2.2
H ₂ O ⁻	0.52
H ₂ O ⁺	4.6

Mineralogy (X-ray):

	%
Quartz	31
Mica	45
Kaolinite	11
Chlorite-	
vermiculite	6
Feldspar	7
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	17.1
Drying shrinkage (%):	2.5
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	7.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	17.8	32.5	1.82
982						
1900	Orange tan	4	5.0	15.2	28.5	1.88
1038						
2000	Orange tan	4	5.0	12.8	25.1	1.97
1093						
2100	Dark red	4	10.0	3.8	8.6	2.28
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Good color at 2100°F. Abrupt vitrification (2000-2100°F). No effervescence with HCl.

Potential uses: Grade SW building brick; sewer pipe.

ALLEGHENY COUNTY Forward Twp. Monongahela quad.

Sample number **28-A-4D**

Location: Pittsburgh Coal Company core drill hole F332 on Sam Warren property, located about 2000 feet (610 m) southwest of Hilldale.

Latitude: 40°14'34"N

Longitude: 79°53'14"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Gray shales from the Birmingham shale unit within the Casselman Formation represent this sample.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core from depths of 354.5 to 360.5 feet (108.1 to 109.9 m)

Chemical analysis:

	%
SiO ₂	51.4
TiO ₂	0.70
Al ₂ O ₃	12.6
Fe ₂ O ₃	0.24
FeO	13.8
MnO	0.55
MgO	2.1
CaO	1.9
Na ₂ O	0.33

Mineralogy (X-ray):

	%
Quartz	22
Mica	49
Kaolinite	0
Chlorite-	
vermiculite	4
Feldspar	5
Montmorillonite	3
Calcite	2
Siderite	15

Chemical analysis:

	%
K ₂ O	1.6
P ₂ O ₅	0.26
S (total)	0.17
C (org.)	0.12
CO ₂	9.1
H ₂ O ⁻	0.42
H ₂ O ⁺	4.1

Raw properties:

Water of plasticity (%): 16.1
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 6.6

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Light brown	3	2.5	17.6	33.4	1.90
982						
1900	Light brown	3	2.5	16.0	31.2	1.95
1038						
2000	Light brown	3	5.0	15.7	31.0	1.98
1093						
2100	Red brown	4	5.0	5.7	13.3	2.35
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor color. Abrupt vitrification (2000-2100°F). No effervescence with HCl.

Potential uses: Grade MW building brick; drain tile.

ALLEGHENY COUNTY Forward Twp. Monongahela quad.Sample number **28-A-4E**

Location: Pittsburgh Coal Company core drill hole F332, on Sam Warren property, located about 2000 feet (610 m) southwest of Hilldale.

Latitude: 40°14'34"N

Longitude: 79°53'14"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Medium-dark-gray shale containing plant fossils represents this sample from the Birmingham shale unit within the Casselman Formation.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core from depths of 363 to 369.9 feet (111 to 112.7 m)

Chemical analysis:

	%
SiO ₂	57.1
TiO ₂	0.94
Al ₂ O ₃	18.4
Fe ₂ O ₃	1.6
FeO	6.2
MnO	0.23
MgO	1.3
CaO	0.45
Na ₂ O	0.43
K ₂ O	3.4
P ₂ O ₅	0.16
S (total)	0.09
C (org.)	1.2
CO ₂	2.0
H ₂ O ⁻	0.73
H ₂ O ⁺	6.2

Mineralogy (X-ray):

	%
Quartz	15
Mica	70
Kaolinite	0
Chlorite-vermiculite	9
Feldspar	6
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 15.6
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 7.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	3	5.0	17.4	32.0	1.84
982						
1900	Light brown	3	5.0	13.7	26.9	1.97
1038						
2000	Light brown	4	7.5	3.8	8.6	2.24
1093						
2100	Red brown	6	10.0	3.0	6.8	2.30
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F in slow-firing test). Abrupt vitrification (1900-2000°F).

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1900	1.30	80.8	13.0	Laminar expansion.
1038				
2000	1.27	79.2	12.6	Laminar expansion.
1093				
2100	0.83	51.8	12.7	Good pore structure.
1149				
2200	0.56	34.9	21.7	Overbloated, sticky.
1204				
2300	--	--	--	--
1260				

Potential uses: Grade MW building brick; Type H floor brick; promising raw material for lightweight aggregate.

ALLEGHENY COUNTY Forward Twp. Monongahela quad.

Sample number **28-A-4G**

Location: Pittsburgh Coal Company core drill hole F332 on the Sam Warren property located about 2000 feet (610 m) southwest of Hilledale.

Latitude: 40°14'34"N

Longitude: 79°53'14"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Very dusky red to blackish-red shales represent this sample from the Birmingham shale unit. Weathered surfaces are colored predominantly olive black, greenish black, and dark greenish gray.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core from depths of 382 to 394 feet (116 to 120 m)

Chemical analysis:

	<i>%</i>
SiO ₂	46.6
TiO ₂	0.78
Al ₂ O ₃	17.8
Fe ₂ O ₃	2.8
FeO	9.6
MnO	0.51
MgO	2.3
CaO	2.7

Mineralogy (X-ray):

	<i>%</i>
Quartz	17
Mica	67
Kaolinite	9
Chlorite-vermiculite	6
Feldspar	1
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.36
K ₂ O	3.5
P ₂ O ₅	0.48
S (total)	0.02
C (org.)	< 0.1
CO ₂	6.1
H ₂ O ⁻	0.70
H ₂ O ⁺	5.4

Raw properties:

Water of plasticity (%): 14.1
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 8.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	15.1	30.0	1.98
982						
1900	Orange tan	4	5.0	11.8	24.3	2.07
1038						
2000	Light brown	4	7.5	9.9	21.3	2.14
1093						
2100	Red brown	4	10.0	4.1	9.5	2.32
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.80	112.3	9.4	No expansion.
1038				
2000	1.50	93.6	8.8	Laminar expansion.
1093				
2100	1.26	78.8	9.3	Mixed bloated and non-bloated.
1149				
2200	1.06	66.1	5.0	Mixed bloated and non-bloated.
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for lightweight aggregate because of mixture of bloating and nonbloating materials.

Potential uses: Grade SW building brick; sewer pipe.

ALLEGHENY COUNTY Forward Twp. Monongahela quad.

Sample number **28-A-4H**

Location: Pittsburgh Coal Company core drill hole F332 on the Sam Warren property, located about 2000 feet (610 m) southwest of Hilddale.

Latitude: 40°14'34"N

Longitude: 79°53'14"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Dark-greenish-gray silty shales containing an occasional thin light-gray siltstone interbed represent this sample from a unit directly above the Morgantown sandstone.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core from depths of 303 to 307 feet (92 to 94 m)

Chemical analysis:

	%
SiO ₂	57.9
TiO ₂	1.0
Al ₂ O ₃	20.0
Fe ₂ O ₃	2.2
FeO	5.3
MnO	0.11
MgO	2.4
CaO	0.24
Na ₂ O	0.85
K ₂ O	3.8
P ₂ O ₅	0.12
S (total)	0.13
C (org.)	0.32
CO ₂	0.06
H ₂ O ⁻	0.56
H ₂ O ⁺	5.4

Mineralogy (X-ray):

	%
Quartz	22
Mica	50
Kaolinite	11
Chlorite-vermiculite	13
Feldspar	4
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%)	18.0
Drying shrinkage (%)	2.5
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	7.4

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Tan	4	2.5	19.0	33.9	1.78

Slow-firing tests:

<i>Temp.</i> <i>(°F)</i> <i>(°C)</i>	<i>Color</i>	<i>Hard-</i> <i>ness</i> <i>(Moh's</i> <i>scale)</i>	<i>%</i> <i>Total</i> <i>shk.</i>	<i>%</i> <i>Absorb.</i>	<i>%</i> <i>App.</i> <i>Por.</i>	<i>Bulk</i> <i>density</i> <i>(gm/cc)</i>
1900	Orange tan	4	5.0	15.7	29.6	1.88
1038						
2000	Orange tan	4	7.5	12.4	24.7	1.99
1093						
2100	Dark red	4	7.5	4.2	9.6	2.27
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Good color (2100°F). Abrupt vitrification (2000-2100°F). No effervescence with HCl.

Potential uses: Grade SW building brick; sewer pipe.

ALLEGHENY COUNTY Forward Twp. Monongahela quad.

Sample number 28-A-41

Location: Pittsburgh Coal Company core drill hole F332 on the Sam Warren property, located about 2000 feet (610 m) southwest of Hilldale.

Latitude: 40°14'34"N Longitude: 79°53'14"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Dark-greenish-gray to dark-gray shale constitutes this sample whose base is about 25 feet (8 m) above the Morgantown sandstone.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core from depths of 270 to 282 feet (82 to 86 m)

Chemical analysis:		Mineralogy (X-ray):	
	<i>%</i>		<i>%</i>
SiO ₂	55.6	Quartz	23
TiO ₂	0.93	Mica	54
Al ₂ O ₃	26.5	Kaolinite	13
Fe ₂ O ₃	3.4	Chlorite-	
FeO	5.0	vermiculite	8
MnO	0.08	Feldspar	2
MgO	2.3	Montmorillonite	0
CaO	0.46	Calcite	0

Chemical analysis:

Na ₂ O	0.24
K ₂ O	4.2
P ₂ O ₅	0.15
S (total)	0.10
C (org.)	0.41
CO ₂	0.02
H ₂ O ⁺	0.79
H ₂ O ⁻	6.1

Raw properties:

Water of plasticity (%):	16.1
Drying shrinkage (%):	2.5
Workability:	Short
Dry strength:	Good
Drying defects:	None
pH:	8.4

Slow-firing tests:

Temp. °F °C	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	14.2	27.4	1.94
982						
1900	Orange tan	4	5.0	10.9	22.4	2.06
1038						
2000	Light brown	4	7.5	7.7	16.9	2.18
1093						
2100	Red brown	6	10.0	1.5	3.7	2.40
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Fair color (1800°F). Slightly effervescent with HCl.

Potential uses: Grade MW building brick; Type FBA facing brick; Type M floor brick.

ALLEGHENY COUNTY Forward Twp. Monongahela quad.

Sample number 28-A-4J

Location: Pittsburgh Coal Company core drill hole F332 on the Sam Warren property located about 2000 feet (610 m) southwest of Hilldale.

Latitude: 40°14'34"N

Longitude: 79°53'14"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Predominantly dark-greenish-gray shales and silty shales make up this sample, which stratigraphically is 38 feet (12 m) above the Morgantown sandstone. A color change occurs in the upper 8.5 inches (21.6 cm) of the sampled interval, where very dusky red to grayish-red clay bands appear.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core from depths of 259.5 to 269.5 feet (79.1 to 82.1 m)

Chemical analysis:

	%
SiO ₂	55.3
TiO ₂	0.96
Al ₂ O ₃	16.9
Fe ₂ O ₃	2.3
FeO	6.2
MnO	0.16
MgO	2.3
CaO	3.1
Na ₂ O	0.57
K ₂ O	2.5
P ₂ O ₅	0.12
S (total)	0.00
C (org.)	<0.1
CO ₂	3.7
H ₂ O ⁻	0.42
H ₂ O ⁺	5.4

Mineralogy (X-ray):

	%
Quartz	27
Mica	44
Kaolinite	9
Chlorite-vermiculite	14
Feldspar	5
Montmorillonite	0
Calcite	14

Raw properties:

Water of plasticity (%): 17.2
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Good
 Drying defects: None
 pH: 8.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	20.5	35.7	1.74
982						
1900	Orange tan	3	5.0	18.3	33.1	1.81
1038						
2000	Light brown	3	5.0	16.3	30.5	1.87
1093						
2100	Red brown	4	7.5	9.2	19.2	2.09
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). Slightly effervescent with HCl. Abrupt vitrification (2100-2200°F).

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	2.12	132.0	7.5	No expansion.
1038				
2000	2.06	128.5	6.6	No expansion.
1093				
2100	1.79	111.7	6.3	Laminar expansion.
1149				
2200	1.38	86.2	7.8	Slightly porous.
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for lightweight aggregate (heavy and limy).**Potential uses:** Grade SW building brick; Type FBS facing brick; drain tile.**ALLEGHENY COUNTY Forward Twp. Monongahela quad.**Sample number **28-A-4K****Location:** Pittsburgh Coal Company core drill hole F 332 on the Sam Warren property located about 2000 feet (610 m) southwest of Hilldale.**Latitude:** 40°14'34"N**Longitude:** 79°53'14"W**Geologic unit:** Casselman Formation, Conemaugh Group**Description:** Dark-greenish-gray silty shales containing some limy veinlets constitute this sample, which occurs about 47 feet (14 m) above the Morgantown sandstone.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Entire core from depths 252 to 259.5 feet (77 to 79.1 m)**Chemical analysis:****Mineralogy (X-ray):**

	<i>%</i>		<i>%</i>
SiO ₂	51.7	Quartz	23
TiO ₂	0.82	Mica	56
Al ₂ O ₃	14.9	Kaolinite	11
Fe ₂ O ₃	1.8	Chlorite-	
FeO	6.7	vermiculite	6
MnO	0.27	Feldspar	1
MgO	2.0	Montmorillonite	0
CaO	5.8	Calcite	3

Chemical analysis:

	%
Na ₂ O	0.35
K ₂ O	2.2
P ₂ O ₅	0.17
S (total)	0.02
C (org.)	0.19
CO ₂	7.2
H ₂ O ⁻	0.57
H ₂ O ⁺	4.8

Raw properties:

Water of plasticity (%): 16.1
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Good
 Drying defects: None
 pH: 8.2

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	18.2	32.8	1.80
982						
1900	Orange tan	4	5.0	17.4	32.0	1.84
1038						
2000	Light brown	4	5.0	16.0	30.1	1.88
1093						
2100	Red brown	6	5.0	12.5	24.7	1.98
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Positive

Remarks: Poor color. Abrupt vitrification (2100-2200°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	2.20	137.3	4.9	No expansion.
1038				
2000	1.88	117.3	4.8	Laminar expansion.
1093				
2100	1.58	98.4	5.7	Laminar expansion.
1149				
2200	0.66	41.2	10.6	Some lumps melted.
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for lightweight aggregate because of mixture of low- and high-temperature bloating materials.

Potential uses: Grade MW building brick.

ALLEGHENY COUNTY Forward Twp. Monongahela quad.

Sample number **28-A-4L**

Location: Pittsburgh Coal Company core drill hole F332 on the Sam Warren property located about 2000 feet (610 m) southwest of Hilldale.

Latitude: 40°14'34"N

Longitude: 79°53'14"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Dark-gray shale containing an occasional marine fossil and siderite band constitutes this sample, which occurs stratigraphically above the Brush Creek coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core from depths of 682 to 692 feet (208 to 210.9 m)

Chemical analysis:

	%
SiO ₂	51.1
TiO ₂	0.86
Al ₂ O ₃	21.4
Fe ₂ O ₃	2.7
FeO	4.9
MnO	0.08
MgO	2.4
CaO	1.5
Na ₂ O	0.30
K ₂ O	4.3
P ₂ O ₅	0.21
S (total)	0.90
C (org.)	0.95
CO ₂	2.1
H ₂ O ⁻	0.88
H ₂ O ⁺	7.1

Mineralogy (X-ray):

	%
Quartz	18
Mica	69
Kaolinite	0
Chlorite-vermiculite	10
Feldspar	2
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%)	16.8
Drying shrinkage (%)	2.5
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	7.9

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	4	5.0	13.8	26.7	1.94
982						
1900	Orange tan	4	5.0	8.3	17.7	2.14
1038						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2000 1093	Orange tan	4	10.0	4.9	11.1	2.28
2100 1149	Dark red	6	10.0	2.2	5.0	2.34
2200 1204	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Good color (2100°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800 982	--	--	--	--
1900 1038	1.48	92.3	13.0	No expansion.
2000 1093	1.43	89.2	14.0	No expansion.
2100 1149	0.88	54.9	14.0	Good pore structure.
2200 1204	0.42	26.0	25.9	Overbloomed; large pores.
2300 1260	--	--	--	--

Potential uses: Grade SW building brick; Type H floor brick; promising raw material for lightweight aggregate.

ARMSTRONG COUNTY Washington Twp. East Brady quad.

Sample number 35-B-5

Location: P & L Coal Company strip pit located about 10,000 feet (3050 m) northwest of Adrian.

Latitude: 40°54'10"N

Longitude: 79°34'10"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Olive-gray to dark-greenish-gray underclay to the Lower Freeport coal is partially exposed in the bottom of the strip pit. Plant debris is abundant throughout the exposed portion of the sampled interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Composite of upper 24 inches (61 cm) of underclay

Chemical analysis:

	%
SiO ₂	57.7
TiO ₂	1.1
Al ₂ O ₃	23.9
Fe ₂ O ₃	1.5
FeO	1.4
MnO	0.00
MgO	1.1
CaO	0.23
Na ₂ O	0.21
K ₂ O	3.0
P ₂ O ₅	0.05
S (total)	0.36
C (org.)	0.66
CO ₂	0.07
H ₂ O ⁻	1.2
H ₂ O ⁺	7.7
Volatiles (excl. H ₂ O, CO ₂)	0.00

Mineralogy (X-ray):

	%
Quartz	12
Mica	62
Kaolinite	22
Chlorite- vermiculite	2
Feldspar	1
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%):	17.5
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Fair
Drying defects:	None
pH:	6.8

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Peach	4	5.0	15.1	28.2	1.87
982						
1900	Peach	4	5.0	13.1	25.3	1.93
1038						
2000	Tan	4	5.0	9.7	20.3	2.10
1093						
2100	Tan	4	10.0	6.2	13.6	2.18
1149						
2200	Buff	6	10.0	3.4	7.7	2.28
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: 16 (1491°C)
(2716°F)

Bloating test: Negative

Remarks: Good color. Might be glazed. No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; low-duty refractories.

ARMSTRONG COUNTY East Franklin Twp. East Brady quad.Sample number **35-B-6****Location:** State Industries, Inc. strip pit located about 2000 feet (610 m) northeast of Adrian.**Latitude:** 40°53'19"N**Longitude:** 79°31'55"W**Geologic unit:** Freeport Formation, Allegheny Group**Description:** Dark-gray to grayish-black claystone occurs immediately above the Upper Kittanning coal. Breaks down easily into hackly fragments, Pyrite occasionally present.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Channel sample from 0 to 11 feet (0 to 3 m) above the Upper Kittanning coal**Chemical analysis:**

	%
SiO ₂	59.5
TiO ₂	0.79
Al ₂ O ₃	17.2
Fe ₂ O ₃	3.4
FeO	3.0
MnO	0.04
MgO	1.7
CaO	0.66
Na ₂ O	0.28
K ₂ O	3.4
P ₂ O ₅	0.36
S (total)	1.9
C (org.)	1.8
CO ₂	0.28
H ₂ O ⁻	1.2
H ₂ O ⁺	5.6
Volatiles (excl. H ₂ O, CO ₂)	1.7

Mineralogy (X-ray):

	%
Quartz	28
Mica	68
Kaolinite	0
Chlorite- vermiculite	3
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	17.5
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	6.3

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	4	5.0	13.5	26.3	1.95
982						
1900	Light brown	4	7.5	9.4	19.7	2.10
1038						
2000	Dark brown	5	10.0	2.6	6.3	2.40
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor color. No effervescence with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.83	114.2	10.5	No expansion.
1038				
2000	1.33	83.0	16.3	Laminar expansion.
1093				
2100	0.90	56.2	16.6	Good pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; drain tile; lightweight aggregate.

ARMSTRONG COUNTY West Franklin Twp. Worthington quad.Sample number **35-C-3A**

Location: Quarry operated by The Logan Clay Products Company located about 2500 feet (760 m) south-southeast of Laird Crossing.

Latitude: 40°51'50"N

Longitude: 79°37'52"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Greenish-gray to light-olive-gray underclay to the Clarion(?) coal is exposed for a total thickness of 5.5 feet (1.7 m). Plant debris is common in parts of the unit. Slacks upon exposure into small hackly fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 5.5 feet (1.7 m) of underclay

Chemical analysis:

	%
SiO ₂	60.0
TiO ₂	1.6
Al ₂ O ₃	24.0
Fe ₂ O ₃	1.2
FeO	0.56
MnO	0.00
MgO	0.64
CaO	0.19
Na ₂ O	0.21
K ₂ O	2.6
P ₂ O ₅	0.05
S (total)	0.02
C (org.)	0.18
CO ₂	0.02
H ₂ O ⁻	0.90
H ₂ O ⁺	7.4
Volatiles (excl. H ₂ O, CO ₂)	0.18

Mineralogy (X-ray):

	%
Quartz	27
Mica	38
Kaolinite	25
Chlorite- vermiculite	8
Feldspar	1
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%): 18.3
 Drying shrinkage (%): 5.0
 Workability: Plastic
 Dry strength: Good
 Drying defects: None
 pH: 6.8

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	5.0	16.4	30.0	1.83
982						
1900	Cream	4	5.0	15.2	28.2	1.86
1038						
2000	Cream	4	5.0	11.4	22.9	2.01
1093						
2100	Ivory	4	10.0	7.6	16.2	2.12
1149						
2200	Ivory	6	10.0	4.7	10.4	2.22
1204						
2300	Gray	6	10.0	2.0	4.5	2.30
1260						

Pyrometric cone equivalent: 26 (1621°C)
(2950°F)

Bloating test: Negative

Remarks: A stoneware type of good quality. Might be glazed. No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; low-duty refractories.

ARMSTRONG COUNTY West Franklin Twp. Worthington quad.Sample number **35-C-3B**

Location: Quarry operated by The Logan Clay Products Company located about 2500 feet (760 m) south-southeast of Laird Crossing.

Latitude: 40°51'50"N

Longitude: 79°37'52"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Light- to medium-gray, massive bed of silty clay occurs from 5.5 to 9.4 feet (1.7 to 2.9 m) below the Clarion(?) coal. Iron staining is moderate to severe. Micaceous flakes visible throughout unit.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 47 inches (119 cm) of silty clay

Chemical analysis:

	%
SiO ₂	66.7
TiO ₂	0.98
Al ₂ O ₃	16.6
Fe ₂ O ₃	2.2
FeO	3.0
MnO	0.04
MgO	0.66
CaO	0.16
Na ₂ O	0.19
K ₂ O	2.2
P ₂ O ₅	0.05
S (total)	0.01
C (org.)	0.22
CO ₂	1.2
H ₂ O ⁻	0.47
H ₂ O ⁺	4.7
Volatiles (excl. H ₂ O, CO ₂)	0.40

Mineralogy (X-ray):

	%
Quartz	38
Mica	32
Kaolinite	26
Chlorite- vermiculite	1
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 15.2
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 6.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	18.1	32.6	1.80
982						
1900	Tan	3	5.0	17.9	32.1	1.80
1038						
2000	Beige	4	5.0	15.2	28.9	1.90
1093						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2100	Light brown	4	5.0	13.3	26.2	1.97
1149						
2200	Light brown	4	5.0	12.3	24.4	1.97
1204						
2300	Gray	6	5.0	5.7	12.5	2.18
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Good color (2000°F). Abrupt vitrification (2200-2300°F). No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick.

ARMSTRONG COUNTY West Franklin Twp. Worthington quad.

Sample number 35-C-3C

Location: Quarry operated by The Logan Clay Products Company located about 2500 feet (760 m) south-southeast of Laird Crossing.

Latitude: 40°51'50"N

Longitude: 79°37'52"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Olive-gray claystone is exposed from 11.2 to 24.2 feet (3.4 to 7.4 m) below the Clarion(?) coal. The claystone lies stratigraphically below a 21-inch (53-cm) sandstone bed which thickens and thins laterally in the exposures in the quarry.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through upper 11 feet (3.4 m) of claystone

Chemical analysis:

Mineralogy (X-ray):

	%		%
SiO ₂	56.6	Quartz	25
TiO ₂	1.3	Mica	42
Al ₂ O ₃	23.8	Kaolinite	30
Fe ₂ O ₃	1.3	Chlorite-	
FeO	2.6	vermiculite	1
MnO	0.00	Feldspar	2
MgO	0.88	Montmorillonite	0
CaO	0.25	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.23
K ₂ O	2.5
P ₂ O ₅	0.12
S (total)	0.01
C (org.)	0.58
CO ₂	0.50
H ₂ O ⁻	1.1
H ₂ O ⁺	7.8
Volatiles (excl. H ₂ O, CO ₂)	0.00

Raw properties:

Water of plasticity (%): 18.5
 Drying shrinkage (%): 5.0
 Workability: Plastic
 Dry strength: Good
 Drying defects: None
 pH: 6.2

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Peach	3	5.0	15.8	29.5	1.87
982						
1900	Peach	4	5.0	14.2	27.3	1.92
1038						
2000	Tan	4	7.5	10.3	21.4	2.09
1093						
2100	Tan	5	10.0	7.3	15.9	2.17
1149						
2200	Tan	5	10.0	4.1	9.4	2.28
1204						
2300	Buff	6	10.0	2.0	4.6	2.26
1260						

Pyrometric cone equivalent: 19 (1541°C)
(2806°F)

Bloating test: Negative

Remarks: Good colors. Might be glazed. No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; low-duty refractories.

ARMSTRONG COUNTY West Franklin Twp. Worthington quad.

Sample number **35-C-3D**

Location: Quarry operated by The Logan Clay Products Company located about 2500 feet (760 m) south-southeast of Laird Crossing.

Latitude: 40°51'50"N

Longitude: 79°37'52"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Medium- to dark-gray, fissile shale occurs from 0 to 12.5 feet (0 to 3.8 m) above the Clarion(?) coal. A band of siderite, 2 inches (5.1 cm) thick, is present 3.5 feet (1.1 m) above the basal contact of the shale.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through lower 8.5 feet (2.5 m) of shale

Chemical analysis:		Mineralogy (X-ray):	
	%		%
SiO ₂	56.8	Quartz	23
TiO ₂	0.91	Mica	49
Al ₂ O ₃	20.7	Kaolinite	23
Fe ₂ O ₃	4.2	Chlorite-	
FeO	2.2	vermiculite	2
MnO	0.01	Feldspar	2
MgO	1.4	Montmorillonite	0
CaO	0.39	Calcite	1
Na ₂ O	0.26		
K ₂ O	3.3		
P ₂ O ₅	0.12		
S (total)	0.32	Raw properties:	
C (org.)	1.5		Water of plasticity (%): 17.5
CO ₂	0.01		Drying shrinkage (%): 2.5
H ₂ O ⁻	0.97		Workability: Short
H ₂ O ⁺	6.7		Dry strength: Fair
Volatiles			Drying defects: None
(excl. H ₂ O, CO ₂)	1.7		pH: 4.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	19.6	34.1	1.74
982						
1900	Orange tan	4	5.0	18.1	32.5	1.80
1038						
2000	Red tan	4	7.5	11.4	23.2	2.03
1093						
2100	Red brown	5	10.0	7.4	15.9	2.16
1149						
2200	Dark brown	6	10.0	4.5	10.1	2.23
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Fair color (2100°F). No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates.

ARMSTRONG COUNTY West Franklin Twp. Worthington quad.

Sample number 35-C-4A

Location: West Freedom Mining Corp. strip pit located about 6000 feet (1830 m) northeast of Craigsville.

Latitude: 40°51'36"N

Longitude: 79°38'04"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Olive-black to brownish-black claystone occurs from 0 to 16 feet (0 to 5 m) above the Middle Kittanning coal. Iron staining is moderate to severe along fracture and bedding surfaces. The claystone breaks into hackly or rubbly, angular-edged fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: From 0 to 16 feet (5 m) above the Middle Kittanning coal

Chemical analysis:		Mineralogy (X-ray):	
	%		%
SiO ₂	55.7	Quartz	19
TiO ₂	0.88	Mica	65
Al ₂ O ₃	20.0	Kaolinite	11
Fe ₂ O ₃	5.7	Chlorite-	
FeO	2.0	vermiculite	4
MnO	0.11	Feldspar	1
MgO	1.4	Montmorillonite	0
CaO	0.21	Calcite	0
Na ₂ O	0.22		
K ₂ O	3.0		
P ₂ O ₅	0.14		
S (total)	0.50	Raw properties:	
C (org.)	2.4		Water of plasticity (%): 19.0
CO ₂	0.01		Drying shrinkage (%): 5.0
H ₂ O ⁻	0.87		Workability: Short
H ₂ O ⁺	6.0		Dry strength: Poor
Volatiles			Drying defects: None
(excl. H ₂ O, CO ₂)	3.4		pH: 5.2

Slow-firing tests:

Temp. (° F) (° C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Tan	3	5.0	22.1	37.5	1.70
1900	Tan	4	5.0	18.1	32.9	1.82
1038						
2000	Orange tan	4	10.0	10.4	22.1	2.12
1093						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2100	Red brown	5	10.0	5.6	12.7	2.25
1149						
2200	Dark brown	6	12.5	2.7	6.3	2.28
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: 13 (1349°C)
(2460°F) Bloating test: Negative

Remarks: Fair color (2100°F). No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBA facing brick.

ARMSTRONG COUNTY West Franklin Twp. Worthington quad.

Sample number **35-C-4B**

Location: West Freedom Mining Corp. strip pit located about 6000 feet (1830 m) northeast of Craigsville.

Latitude: 40°51'36"N

Longitude: 79°38'04"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Grayish-black, relatively soft claystone occurs stratigraphically above the Lower Kittanning(?) coal. Siderite bands up to 0.5 inch (1.3 cm) in thickness are present occasionally in the interval. The claystone breaks into platy, angular fragments. Iron staining is minor in amount.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 10 stratigraphic feet (3 m) of claystone

Chemical analysis:

Mineralogy (X-ray):

	%		%
SiO ₂	52.2	Quartz	19
TiO ₂	0.93	Mica	57
Al ₂ O ₃	22.0	Kaolinite	20
Fe ₂ O ₃	3.3	Chlorite-	
FeO	3.8	vermiculite	2
MnO	0.17	Feldspar	1
MgO	1.9	Montmorillonite	0
CaO	0.46	Calcite	1

Chemical analysis:

	%
Na ₂ O	0.18
K ₂ O	3.3
P ₂ O ₅	0.26
S (total)	1.4
C (org.)	1.6
CO ₂	0.70
H ₂ O ⁻	0.98
H ₂ O ⁺	7.3
Volatiles (excl. H ₂ O, CO ₂)	1.6

Raw properties:

Water of plasticity (%): 19.1
 Drying shrinkage (%): 2.5
 Workability: Plastic
 Dry strength: Good
 Drying defects: None
 pH: 5.2

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	3	5.0	16.7	30.8	1.85
982						
1900	Light brown	4	5.0	12.4	24.7	1.99
1038						
2000	Medium brown	4	10.0	4.2	9.7	2.31
1093						
2100	Dark brown	6	15.0	2.1	4.9	2.33
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: 7 (1264°C)
(2307°F)

Bloating test: Positive

Remarks: Poor color. No effervescence with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.13	70.5	16.3	Mixed bloated and non-bloated.
1038				
2000	0.66	41.2	34.0	Mixed bloated and non-bloated.
1093				
2100	0.91	56.8	17.2	Mixed bloated and non-bloated.
1149				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for use in lightweight aggregate (mixture of bloating and nonbloating materials).

Potential uses: Grade SW building brick; Type FBA facing brick; Type H floor brick.

ARMSTRONG COUNTY East Franklin Twp. Kittanning quad.

Sample number **35-D-2A**

Location: B & G Construction Company strip pit located about 7500 feet (2290 m) northwest of Furnace Run.

Latitude: 40°51'44"N

Longitude: 79°34'31"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Olive-black to brownish-black claystone occurs from 0 to 12 feet (0 to 4 m) stratigraphically above the Upper Freeport coal. Bedding poorly developed. Conchoidal fractures common. Fragments are commonly hackly to platy and have angular edges. Upper contact of claystone defined by a 1.5-inch (3.8-cm) band of siderite.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 12 stratigraphic feet (4 m) of claystone

Chemical analysis:**Mineralogy (X-ray):**

	<i>%</i>		<i>%</i>
SiO ₂	55.4	Quartz	22
TiO ₂	0.90	Mica	49
Al ₂ O ₃	20.3	Kaolinite	21
Fe ₂ O ₃	1.9	Chlorite-	
FeO	5.1	vermiculite	4
MnO	0.08	Feldspar	1
MgO	1.8	Montmorillonite	3
CaO	0.47	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.23
K ₂ O	3.0
P ₂ O ₅	0.12
S (total)	0.42
C (org.)	1.2
CO ₂	2.0
H ₂ O ⁻	0.64
H ₂ O ⁺	5.8
Volatiles (excl. H ₂ O, CO ₂)	1.0

Raw properties:

Water of plasticity (%): 16.5
 Drying shrinkage (%): 0.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 6.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	3	5.0	16.8	30.9	1.84
982						
1900	Orange tan	4	5.0	14.8	28.4	1.91
1038						
2000	Light brown	4	10.0	8.9	18.9	2.12
1093						
2100	Red brown	6	10.0	4.7	10.8	2.28
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). No effervescence with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.43	89.2	14.5	Laminar expansion.
1038				
2000	1.02	63.6	19.5	Mixed bloated and non-bloated.
1093				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2100	0.74	46.1	13.1	Mixed bloated and non-bloated.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for use in lightweight aggregate (mixture of bloating and nonbloating materials).

Potential uses: Grade SW building brick; Type FBA facing brick.

ARMSTRONG COUNTY East Franklin Twp. Kittanning quad.

Sample number **35-D-2B**

Location: B & G Construction Company strip pit located about 7500 feet (2290 m) northeast of Furnace Run.

Latitude: 40°51'44"N

Longitude: 79°34'31"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Dark-greenish-gray claystone occurs from 12 to 19 feet (4 to 6 m) above the Upper Freeport coal and immediately above sample 35-D-2A. Fragments of claystone are commonly platy to hackly and have angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 7 feet (2.1 m) of claystone

Chemical analysis:**Mineralogy (X-ray):**

	<i>%</i>		<i>%</i>
SiO ₂	61.6	Quartz	29
TiO ₂	1.0	Mica	36
Al ₂ O ₃	20.0	Kaolinite	28
Fe ₂ O ₃	1.5	Chlorite-	
FeO	3.3	vermiculite	6
MnO	0.01	Feldspar	1
MgO	1.8	Montmorillonite	0
CaO	0.42	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.24
K ₂ O	2.9
P ₂ O ₅	0.11
S (total)	0.04
C (org.)	0.32
CO ₂	0.48
H ₂ O ⁻	0.68
H ₂ O ⁺	5.3
Volatiles (excl. H ₂ O, CO ₂)	0.42

Raw properties:

Water of plasticity (%):	16.3
Drying shrinkage (%):	2.5
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	6.8

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	14.6	28.0	1.90
982						
1900	Tan	4	5.0	14.5	27.5	1.91
1038						
2000	Orange tan	4	10.0	9.4	19.7	2.11
1093						
2100	Light brown	5	10.0	4.3	9.7	2.24
1149						
2200	Gray brown	5	10.0	3.2	7.5	2.33
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: 5 (1221°C)
(2230°F) Bloating test: Negative

Remarks: Poor color. No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe.

ARMSTRONG COUNTY East Franklin Twp. Kittanning quad.

Sample number **35-D-7**

Location: L & E Construction Company strip pit located about 12,000 feet (3660 m) northwest of Tarrtown.

Latitude: 40°52'20"N

Longitude: 79°33'14"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-dark-gray silty underclay to the Mahoning coal is exposed in this stripping. The underclay is 6 feet (1.8 m) thick and contains stringers of coal in its upper portion. Fragments of the underclay are hackly and have angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel through 6 feet (1.8 m) of underclay

Chemical analysis:

	%
SiO ₂	58.7
TiO ₂	0.88
Al ₂ O ₃	18.7
Fe ₂ O ₃	1.5
FeO	4.4
MnO	0.05
MgO	1.8
CaO	0.98
Na ₂ O	0.33
K ₂ O	2.8
P ₂ O ₅	0.13
S (total)	0.16
C (org.)	0.12
CO ₂	2.3
H ₂ O ⁻	1.0
H ₂ O ⁺	5.1
Volatiles (excl. H ₂ O, CO ₂)	0.00

Mineralogy (X-ray):

	%
Quartz	31
Mica	52
Kaolinite	7
Chlorite- vermiculite	7
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	16.5
Drying shrinkage (%):	2.5
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	8.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	14.7	28.0	1.90
982						
1900	Tan	4	5.0	13.4	26.3	1.96
1038						
2000	Light brown	4	7.5	8.4	18.3	2.17
1093						
2100	Dark brown	6	10.0	1.3	2.9	2.24
1149						
2200	Gray brown	6	10.0	1.3	3.0	2.27
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor color. Slightly effervescent with HCl.

Potential uses: Grade SW building brick; Type FBA facing brick.

ARMSTRONG COUNTY Wayne Twp. Distant quad.

Sample number **45-B-1**

Location: Earl Houser strip pit located about 10,000 feet (3050 m) east-northeast of Goheenville.

Latitude: 40°54'35"N

Longitude: 79°20'06"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-gray to greenish-gray, slightly silty claystone occurs from 3 to 13 feet (0.9 to 4 m) above the Upper Freeport coal. Bedding is poorly developed. Orange and brown iron staining is common along fractures.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 10 feet (3 m) of claystone

Chemical analysis:		Mineralogy (X-ray):	
	%		%
SiO ₂	60.5	Quartz	30
TiO ₂	0.85	Mica	57
Al ₂ O ₃	19.3	Kaolinite	5
Fe ₂ O ₃	3.7	Chlorite-	
FeO	2.1	vermiculite	5
MnO	0.05	Feldspar	3
MgO	1.8	Montmorillonite	0
CaO	0.31	Calcite	0
Na ₂ O	0.14		
K ₂ O	3.3		
P ₂ O ₅	0.15		
S (total)	0.43	Raw properties:	
C (org.)	0.26		
CO ₂	0.03		
H ₂ O ⁻	0.92		
H ₂ O ⁺	5.6		
Volatiles			
(excl. H ₂ O, CO ₂)	0.00		
		Water of plasticity (%)	16.7
		Drying shrinkage (%)	2.5
		Workability	Short
		Dry strength	Poor
		Drying defects	None
		pH	8.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	16.4	30.9	1.88
982						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1900	Tan	4	5.0	13.8	26.5	1.92
1038						
2000	Orange tan	4	10.0	9.6	20.3	2.12
1093						
2100	Red tan	4	10.0	8.0	17.6	2.21
1149						
2200	Red brown	5	10.0	0.6	1.4	2.29
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Poor color. No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBA facing brick; Type L floor brick.

ARMSTRONG COUNTY Wayne Twp. Distant quad.

Sample number 45-B-2A

Location: Markle Bullers Coal Company strip pit located about 9000 feet (2740 m) northwest of Belknap.

Latitude: 40°55'03"N

Longitude: 79°19'24"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Greenish-gray, medium-gray, and brownish-gray underclay to the Upper Freeport coal is exposed for a total thickness of 5 feet (1.5 m). A massive limestone, 4.5 feet (1.4 m) thick, underlies the underclay. The underclay breaks into hackly fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 5 feet (1.5 m) of underclay

Chemical analysis:

Mineralogy (X-ray):

	%		%
SiO ₂	56.2	Quartz	25
TiO ₂	1.1	Mica	42
Al ₂ O ₃	22.6	Kaolinite	28
Fe ₂ O ₃	1.9	Chlorite-	
FeO	1.5	vermiculite	2
MnO	0.00	Feldspar	1
MgO	0.94	Montmorillonite	0

Chemical analysis:

	%
CaO	0.63
Na ₂ O	0.18
K ₂ O	2.5
P ₂ O ₅	0.21
S (total)	0.92
C (org.)	2.0
CO ₂	0.03
H ₂ O ⁻	1.4
H ₂ O ⁺	7.7
Volatiles (excl. H ₂ O, CO ₂)	2.2

Mineralogy (X-ray):

	%
Calcite	0
Gypsum	1
Pyrophyllite present	
Siderite present	

Raw properties:

Water of plasticity (%):	16.0
Drying shrinkage (%):	0.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	5.9

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Peach	3	5.0	16.7	30.5	1.83
982						
1900	Tan	4	5.0	16.3	30.0	1.84
1038						
2000	Tan	4	7.5	11.0	22.5	2.04
1093						
2100	Buff	4	10.0	7.7	16.2	2.09
1149						
2200	Buff	6	10.0	4.9	10.6	2.18
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: 14 (1398°C)
(2548°F)

Bloating test: Negative

Remarks: Fair color (2100°F). No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick.

ARMSTRONG COUNTY Wayne Twp. Distant quad.

Sample number **45-B-2B**

Location: Markle Bullers Coal Company strip pit located about 9000 feet (2740 m) northwest of Belknap.

Latitude: 40°55'03"N

Longitude: 79°19'24"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Medium-gray to medium-dark-gray claystone and silty claystone beds occur above the Lower Freeport coal for a stratigraphic thickness of 14 feet (4 m). Beds become thicker towards the top of the claystone interval. Broken fragments of the claystone are platy to hackly and have angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel from 0 to 10 feet (0 to 3 m) above the coal

Chemical analysis:

	%
SiO ₂	56.0
TiO ₂	1.0
Al ₂ O ₃	20.0
Fe ₂ O ₃	1.9
FeO	4.9
MnO	0.02
MgO	1.6
CaO	0.98
Na ₂ O	0.23
K ₂ O	3.4
P ₂ O ₅	0.24
S (total)	0.07
C (org.)	0.60
CO ₂	2.6
H ₂ O ⁻	0.76
H ₂ O ⁺	5.3
Volatiles (excl. H ₂ O, CO ₂)	0.00

Mineralogy (X-ray):

	%
Quartz	25
Mica	55
Kaolinite	11
Chlorite- vermiculite	8
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	15.6
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	8.0

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	5.0	15.4	28.9	1.88
982						
1900	Tan	4	5.0	13.4	26.6	1.99
1038						
2000	Orange tan	4	5.0	7.8	16.9	2.17
1093						
2100	Light brown	4	10.0	4.0	9.1	2.26
1149						
2200	Dark brown	6	10.0	1.9	4.5	2.31
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: 12 (1337°C)
(2439°F) Bloating test: Negative

Remarks: Poor color. Slightly effervescent with HCl.

Potential uses: Grade SW building brick.

ARMSTRONG COUNTY Wayne Twp. Distant quad.

Sample number **45-B-3**

Location: Markle Bullers Coal Company strip pit located about 8500 feet
(2590 m) south of Putneyville.

Latitude: 40°55'23"N Longitude: 79°19'04"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Greenish-gray, slightly silty claystone occurs for a thickness of approximately 30 feet (9 m) above the Upper Freeport coal. Poorly defined beds range from about 7 inches (18 cm) to more than a foot (0.3 m) in thickness. Conchoidal fracturing is common. Moderate to severe orange-brown iron staining is present along the fractures. Pyrite occurs occasionally in beds close to the coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through lower 10 feet (3 m) of claystone

Chemical analysis:

	%
SiO ₂	60.5
TiO ₂	0.90
Al ₂ O ₃	18.9
Fe ₂ O ₃	2.5
FeO	3.5
MnO	0.04
MgO	1.9
CaO	0.47
Na ₂ O	0.14
K ₂ O	3.2
P ₂ O ₅	0.16
S (total)	0.13
C (org.)	0.53
CO ₂	0.60
H ₂ O ⁻	0.81
H ₂ O ⁺	5.1
Volatiles (excl. H ₂ O, CO ₂)	0.15

Mineralogy (X-ray):

	%
Quartz	37
Mica	53
Kaolinite	3
Chlorite- vermiculite	6
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 17.3
Drying shrinkage (%): 0.0
Workability: Short
Dry strength: Fair
Drying defects: None
pH: 8.1

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	5.0	16.4	30.5	1.85
982						
1900	Tan	4	5.0	14.6	27.7	1.90
1038						
2000	Orange tan	4	7.5	9.6	20.3	2.12
1093						
2100	Red brown	4	10.0	4.7	10.4	2.22
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Poor color. Slightly effervescent with HCl.

Potential uses: Grade SW building brick; drain tile.

ARMSTRONG COUNTY Redbank Twp. Distant quad.

Sample number 45-B-4A

Location: Harmon Coal Company strip pit located about 4500 feet (1370 m) south-southeast of Charlestown.

Latitude: 40°56'54"N

Longitude: 79°15'13"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Gray-black fissile shale containing an estimated 5 percent of siderite nodules occurs above the Lower Kittanning coal. The shale is broken easily and forms papery to platy fragments having angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel from 0 to 9 feet (0 to 2.7 m) above the coal

Chemical analysis:

Mineralogy (X-ray):

	%		%
SiO ₂	50.2	Quartz	11
TiO ₂	0.81	Mica	66
Al ₂ O ₃	21.7	Kaolinite	11
Fe ₂ O ₃	3.1	Chlorite-	
FeO	5.3	vermiculite	5

Chemical analysis:

	%
MnO	0.24
MgO	2.1
CaO	0.48
Na ₂ O	0.22
K ₂ O	3.7
P ₂ O ₅	0.23
S (total)	1.2
C (org.)	1.3
CO ₂	1.5
H ₂ O ⁻	0.96
H ₂ O ⁺	6.1
Volatiles (excl. H ₂ O, CO ₂)	2.0

Mineralogy (X-ray):

	%
Feldspar	2
Montmorillonite	0
Calcite	0
Siderite	3
Pyrite present	
Goethite present	

Raw properties:

Water of plasticity (%):	18.1
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	7.2

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	15.2	28.8	1.89
982						
1900	Light brown	4	10.0	11.5	23.3	2.03
1038						
2000	Light brown	4	10.0	5.9	13.4	2.25
1093						
2100	Red brown	6	10.0	2.1	5.0	2.37
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor color. Slight effervescence with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	1.85	115.4	14.8	No expansion.
982				
1900	0.91	56.7	11.0	Mixed bloated and non-bloated.
1038				

Bloating tests (quick-firing):

Temp. (°F) (°C)	Bulk density		% Absorb.	Remarks
	(gm/cc)	(lb/ft ³)		
2000	--	--	--	Melted.
1093				
2100	--	--	--	--
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for use in lightweight aggregate (mixture of bloating and nonbloating materials).

Potential uses: Grade SW building brick.

ARMSTRONG COUNTY Redbank Twp. Distant quad.

Sample number **45-B-4B**

Location: Harmon Coal Company strip pit located about 4500 feet (1370 m) south-southeast of Charlestown.

Latitude: 40°56'54"N

Longitude: 79°15'13"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Grayish-black silty claystone occurs from 9 to 19 feet (2.7 to 5.8 m) above the Lower Kittanning coal. Unlike sample 45-B-4A, siderite nodules are not present. Commonly breaks into platy fragments having angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel from 9 to 19 feet (2.7 to 5.8 m) above coal

Chemical analysis:

	%
SiO ₂	55.2
TiO ₂	0.93
Al ₂ O ₃	19.9
Fe ₂ O ₃	3.1
FeO	4.0
MnO	0.06
MgO	1.8
CaO	0.41

Mineralogy (X-ray):

	%
Quartz	23
Mica	57
Kaolinite	15
Chlorite- vermiculite	4
Feldspar	1
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.25
K ₂ O	3.3
P ₂ O ₅	0.24
S (total)	1.3
C (org.)	1.9
CO ₂	0.28
H ₂ O ⁻	0.79
H ₂ O ⁺	6.5
Volatiles (excl. H ₂ O, CO ₂)	2.0

Raw properties:

Water of plasticity (%): 14.8
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 7.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	17.4	31.6	1.82
982						
1900	Orange tan	4	5.0	15.8	29.6	1.88
1038						
2000	Red tan	4	5.0	10.0	20.8	2.08
1093						
2100	Dark red	5	10.0	4.0	8.9	2.22
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.49	92.9	16.1	Slight expansion.
1038				
2000	1.38	86.1	18.4	Slight expansion.
1093				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2100	0.92	57.4	22.5	Some overbloated lumps.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for use in lightweight aggregate (mixture of bloating and poor bloating materials).

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe.

ARMSTRONG COUNTY Burrell Twp. Whitesburg quad.

Sample number **46-A-1A**

Location: Fiore Development Corporation strip pit located about 8000 feet (2440 m) west-northwest of the village of Cochrans Mills.

Latitude: 40°40'22"N

Longitude: 79°29'19"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Grayish-black to black, carbonaceous claystone occurs from 0 to 12 feet (0 to 4 m) above the Mahoning coal. Pyrite stringers are present occasionally in the lower part of this unit. Conchoidal fractures are common in the claystone. Beds range from 3 to 18 inches (7.6 to 46 cm) in thickness.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through entire 12 feet (4 m) of claystone

Chemical analysis:

	<i>%</i>
SiO ₂	50.9
TiO ₂	0.79
Al ₂ O ₃	17.6
Fe ₂ O ₃	2.7
FeO	4.6
MnO	0.06
MgO	1.9
CaO	0.93

Mineralogy (X-ray):

	<i>%</i>
Quartz	20
Mica	59
Kaolinite	15
Chlorite-	
vermiculite	5
Feldspar	1
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.15
K ₂ O	2.8
P ₂ O ₅	0.28
S (total)	2.2
C (org.)	7.0
CO ₂	1.6
H ₂ O ⁻	1.0
H ₂ O ⁺	6.8
Volatiles (excl. H ₂ O, CO ₂)	6.3

Raw properties:

Water of plasticity (%): 16.3
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 8.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Orange tan	3	5.0	19.3	33.8	1.75
982						
1900	Orange tan	4	5.0	17.0	31.2	1.83
1038						
2000	Red tan	4	10.0	10.6	21.7	2.06
1093						
2100	Red brown	5	10.0	6.4	12.9	2.00
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color (2100°F). Slightly effervescent with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick.

ARMSTRONG COUNTY Burrell Twp. Whitesburg quad.

Sample number 46-A-1B

Location: Fiore Development Corporation strip pit located about 8000 feet (2444 m) west-northwest of the village of Cochran's Mills.

Latitude: 40°40'22"N

Longitude: 79°29'19"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Dark-greenish-gray, slightly silty claystones occur above sample 46-A-1A and from 12 to 24 feet (4 to 7 m) above the Mahoning coal. Thin- to medium-bedded sequence; beds range from about 10 inches (25 cm) to 18 inches (46 cm) in thickness. Iron staining common along fractures.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Chemical analysis:

	%
SiO ₂	54.9
TiO ₂	0.94
Al ₂ O ₃	19.9
Fe ₂ O ₃	1.7
FeO	3.7
MnO	0.03
MgO	2.4
CaO	2.6
Na ₂ O	0.21
K ₂ O	2.9
P ₂ O ₅	0.13
S (total)	0.09
C (org.)	0.10
CO ₂	3.0
H ₂ O ⁻	0.77
H ₂ O ⁺	5.6
Volatiles (excl. H ₂ O, CO ₂)	0.15

Mineralogy (X-ray):

	%
Quartz	24
Mica	54
Kaolinite	11
Chlorite-	
vermiculite	7
Feldspar	3
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%):	16.4
Drying shrinkage (%):	2.5
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	9.2

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Tan	3	5.0	17.3	31.7	1.83
982						
1900	Orange tan	4	5.0	14.7	28.4	1.93
1038						
2000	Red tan	4	10.0	10.9	22.4	2.05
1093						
2100	Medium brown	5	10.0	6.2	13.2	2.15
1149						
2200	Dark brown	6	10.0	3.9	8.7	2.23
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor color. Highly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.98	123.6	10.9	No expansion.
1038				
2000	1.69	105.5	8.6	Laminar expansion.
1093				
2100	1.23	76.8	6.0	Fair pore structure.
1149				
2200	1.15	71.8	8.2	Fair pore structure.
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate (heavy).

Potential uses: Grade SW building brick; drain tile.

ARMSTRONG COUNTY South Bend Twp. Avondale quad.

Sample number **46-C-2A**

Location: Rochester and Pittsburgh Coal Company stirp pit located about 4000 feet (1220 m) northeast of Olivet.

Latitude: 40°35'28"N

Longitude: 79°23'58"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Olive-gray to olive-black, medium-bedded claystones occur from 0 to 10 feet (0 to 3 m) above the Pittsburgh coal. Two thin sandstone beds are present near the top of the unit; one is 3 inches (7.6 cm) thick, the other 5 inches (12.7 cm) thick. The claystone beds range in thickness from 3 inches (7.6 cm) up to about 12 inches (30.5 cm).

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: From 0 to 10 feet (0 to 3 m) above the Pittsburgh coal

Chemical analysis:

Mineralogy (X-ray):

	<i>%</i>		<i>%</i>
SiO ₂	54.0	Quartz	17
TiO ₂	0.92	Mica	45
Al ₂ O ₃	19.8	Kaolinite	32
Fe ₂ O ₃	1.6	Chlorite-	
FeO	6.6	vermiculite	2
MnO	0.12	Feldspar	2
MgO	1.5	Montmorillonite	2
CaO	0.50	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.31
K ₂ O	3.0
P ₂ O ₅	0.14
S (total)	0.13
C (org.)	1.2
CO ₂	Not reported
H ₂ O ⁻	0.73
H ₂ O ⁺	5.1
Volatiles (excl. H ₂ O, CO ₂)	2.4

Raw properties:

Water of plasticity (%): 18.0
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 8.7

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	3	5.0	19.6	34.5	1.76
982						
1900	Beige	4	5.0	17.4	32.1	1.84
1038						
2000	Light brown	4	10.0	11.4	23.6	2.07
1093						
2100	Red brown	6	10.0	6.2	13.6	2.20
1149						
2200	Dark brown	6	10.0	4.1	9.4	2.30
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.46	91.1	7.3	Laminar expansion.
1038				
2000	1.31	81.7	12.9	Laminar expansion.
1093				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2100 1149	0.79	49.3	17.8	Some overbloomed lumps.
2200 1204	--	--	--	--
2300 1260	--	--	--	--

Remarks: Not suitable for use in lightweight aggregate (mixture of low- and high-temperature bloating materials).

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates.

ARMSTRONG COUNTY South Bend Twp. Avondale quad.

Sample number **46-C-2B**

Location: Rochester and Pittsburgh Coal Company strip pit located about 4000 feet (1220 m) northeast of Olivet.

Latitude: 40°35'28"N

Longitude: 79°23'58"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Olive-black to brownish-black, medium-bedded claystone occurs directly above claystone sample 46-C-2A and is from 10 to 19 feet (3 to 6 m) above the Pittsburgh coal. Beds range from about 3 to 12 inches (7.6 to 30 cm) in thickness.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel from 10 to 19 feet (3 to 6 m) above coal

Chemical analysis:		Mineralogy (X-ray):	
	<i>%</i>		<i>%</i>
SiO ₂	53.6	Quartz	13
TiO ₂	0.91	Mica	53
Al ₂ O ₃	21.8	Kaolinite	29
Fe ₂ O ₃	1.5	Chlorite-	
FeO	5.2	vermiculite	4
MnO	0.06	Feldspar	1
MgO	1.7	Montmorillonite	0
CaO	0.40	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.29
K ₂ O	3.4
P ₂ O ₅	0.14
S (total)	0.28
C (org.)	2.0
CO ₂	Not reported
H ₂ O ⁻	0.87
H ₂ O ⁺	5.9
Volatiles (excl. H ₂ O, CO ₂)	1.0

Raw properties:

Water of plasticity (%):	17.5
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	8.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	17.2	31.3	1.82
982						
1900	Orange tan	4	5.0	13.4	26.3	1.96
1038						
2000	Red tan	4	5.0	8.7	18.6	2.14
1093						
2100	Red brown	6	10.0	3.6	8.3	2.30
1149						
2200	Dark brown	6	10.0	2.0	4.8	2.33
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: 8 (1300°C)
(2372°F)

Bloating test: Positive

Remarks: Fair color (2100°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.61	100.5	9.6	Slight laminar expansion.
1038				
2000	0.98	61.7	16.5	Mixed bloated and non-bloated.
1093				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i>		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
	(gm/cc)	(lb/ft ³)		
2100	0.94	58.7	11.1	Mixed bloated and non-bloated.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for use in lightweight aggregate (mixture of low- and high-temperature bloating materials).

Potential uses: Grade SW building brick; FBS facing brick; sewer pipe; liner plates.

BEAVER COUNTY Ohio Twp. East Liverpool North quad.

Sample number **0.6-B-1**

Location: Exposure along the north side of Pa. Route 68, about 2000 feet (610 m) east of the village of Glasgow and 850 feet (260 m) east of Upper Dry Run.

Latitude: 40°38'52"N

Longitude: 80°30'01"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Material underlies 11 inches (28 cm) of coal and consists of: 0.8 foot (0.2 m) of fissile to thin-bedded, carbonaceous shale; 3.5 feet (1.1 m) of dark-gray silty claystone; 0.5 foot (0.2 m) of very dark gray fissile shale; and 0.4 foot (0.1 m) of hard sandy claystone. Interval occurs stratigraphically under the Middle Kittanning coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 5.2 feet (1.6 m) of material underneath coal

Chemical analysis:**Mineralogy (X-ray):**

	%		%
SiO ₂	60.0	Quartz	31
TiO ₂	1.3	Mica	52
Al ₂ O ₃	20.6	Kaolinite	13
Fe ₂ O ₃	1.4	Chlorite-	
FeO	0.8	vermiculite	3
MnO	0.0	Feldspar	1
MgO	0.7	Montmorillonite	0
CaO	0.21	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.2
K ₂ O	2.0
P ₂ O ₅	0.17
S (total)	0.25
C (org.)	4.5
CO ₂	0.7
H ₂ O ⁻	1.3
H ₂ O ⁺	7.4
Volatiles (excl. H ₂ O, CO ₂)	3.9

Raw properties:

Water of plasticity (%): 20.0
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 3.3

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Peach	2	5.0	23.9	38.1	1.60
982						
1900	Peach	3	5.0	20.4	34.6	1.69
1038						
2000	Tan	3	10.0	19.7	33.3	1.69
1093						
2100	Tan	3	10.0	18.0	31.6	1.75
1149						
2200	Buff	4	10.0	15.4	28.2	1.83
1204						
2300	Gray buff	5	10.0	9.3	18.5	1.98
1260						

Pyrometric cone equivalent: 17 (1512°C)
(2754°F) **Bloating test:** Negative

Remarks: Low plasticity. Good color at 2200°F.

Potential uses: Grade SW building brick; Type FBS facing brick; low-duty refractory.

BEAVER COUNTY Darlington Twp. New Galilee quad.

Sample number 5-C-15

Location: Coal stripping operated by the Dodds Coal Company, located about 10,000 feet (3050 m) west-northwest of New Galilee and about 800 feet (240 m) west of the intersection of Madden Run, Madden Run Road, and Echo Valley Road.

Latitude: 40°50'25"N

Longitude: 80°26'18"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Sixteen stratigraphic feet (5 m) of shale above the Lower Kittanning coal. The lower half consists of medium- to dark-gray, fissile to thin-bedded silty shales containing some siderite nodules that range from 0.1 to 0.15 feet (0.03 to 0.04 m) in their long dimension. The upper 8 feet (2.4 m) of the section consists of thin-bedded gray shales that are tinged with brown. The shales break down into hackly to platy fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered to moderately weathered

Sampled interval: Composite of 16 stratigraphic feet (5 m)

Chemical analysis:		Mineralogy (X-ray):	
	%		%
SiO ₂	62.4	Quartz	31
TiO ₂	1.2	Mica	50
Al ₂ O ₃	19.2	Kaolinite	5
Fe ₂ O ₃	1.8	Chlorite-	
FeO	2.5	vermiculite	6
MnO	0.03	Feldspar	3
MgO	1.4	Montmorillonite	5
CaO	0.29	Calcite	0
Na ₂ O	0.31		
K ₂ O	3.0		
P ₂ O ₅	0.11		
S (total)	0.40	Raw properties:	
C (org.)	1.1	Water of plasticity (%): 19.0	
CO ₂	0.06	Drying shrinkage (%): 5.0	
H ₂ O ⁻	0.89	Workability: Short	
H ₂ O ⁺	6.0	Dry strength: Poor	
Volatiles		Drying defects: None	
(excl. H ₂ O, CO ₂)	0.34	pH: 4.8	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	5.0	17.0	30.9	1.81
982						
1900	Salmon	3	5.0	13.9	26.6	1.91
1038						
2000	Orange tan	3	5.0	12.5	24.4	1.95
1093						
2100	Orange tan	4	7.5	10.7	21.6	2.01
1149						
2200	Light brown	5	7.5	7.2	15.5	2.14
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Low plasticity; poor colors in slow-firing tests.

Potential uses: Grade SW building brick; Type FBA facing brick.

BEAVER COUNTY Darlington Twp. New Galilee quad.Sample number **5-C-16**

Location: Coal stripping operated by the Dodds Coal Company located about 10,000 feet (3050 m) west-northwest of New Galilee and about 800 feet (240 m) west of the intersection of Madden Run, Madden Run Road, and Echo Valley Road.

Latitude: 40°50'25"N**Longitude:** 80°26'18"W**Geologic unit:** Kittanning Formation, Allegheny Group

Description: Light- to light-medium-gray claystone containing abundant siderite nodules. The nodules are silver gray in color on the inside, and their exterior surfaces are covered in large part with medium sand-sized depressions that may be related to the weathering of iron sulfide. Sampled interval is stratigraphically from 5.5 to 14.5 feet (1.7 to 4.4 m) below the Middle Kittanning coal.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Channel through 9 stratigraphic feet (2.7 m)**Chemical analysis:**

	%
SiO ₂	55.8
TiO ₂	0.9
Al ₂ O ₃	23.0
Fe ₂ O ₃	1.7
FeO	3.6
MnO	0.03
MgO	1.8
CaO	0.46
Na ₂ O	0.60
K ₂ O	4.1
P ₂ O ₅	0.24
S (total)	0.1
C (org.)	0.67
CO ₂	0.06
H ₂ O ⁻	1.0
H ₂ O ⁺	6.5
Volatiles	
(excl. H ₂ O, CO ₂)	0.0

Mineralogy (X-ray):

	%
Quartz	16
Mica	56
Kaolinite	22
Chlorite-	
vermiculite	4
Feldspar	2
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	19.5
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	5.7

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	2	5.0	15.6	29.1	1.86
982						
1900	Salmon	3	5.0	10.8	21.9	2.02
1038						
2000	Orange tan	4	10.0	8.6	17.8	2.08
1093						
2100	Light red	6	10.0	7.4	15.7	2.13
1149						
2200	Dark brown	7	10.0	6.8	14.9	2.21
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: 14 (1398°C)
(2548°F) Bloating test: Negative

Remarks: Low plasticity.

Potential uses: Grade SW building brick; Type FBS facing brick.

BEAVER COUNTY Darlington Twp. New Galilee quad.

Sample number **5-C-17**

Location: Coal stripping operated by the Dodds Coal Company located about 10,000 feet (3050 m) west-northwest of New Galilee and about 800 feet (240 m) west of the intersection of Madden Run, Madden Run Road, and Echo Valley Road.

Latitude: 40°50'25"N

Longitude: 80°26'18"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Gray, plastic, slightly silty underclay to the Middle Kittanning coal. Some iron staining along exposed surfaces. Breaks into hackly fragments. Slight effervescence when treated with dilute HCl.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through entire interval (5.5 feet, or 1.7 m) of plastic underclay

Chemical analysis:

	<i>%</i>
SiO ₂	54.6
TiO ₂	1.2
Al ₂ O ₃	25.0
Fe ₂ O ₃	3.1
FeO	0.68
MnO	0.02
MgO	0.87
CaO	0.29

Mineralogy (X-ray):

	<i>%</i>
Quartz	20
Mica	46
Kaolinite	33
Chlorite- vermiculite	0
Feldspar	1
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.32
K ₂ O	2.7
P ₂ O ₅	0.16
S (total)	1.6
C (org.)	0.50
CO ₂	0.02
H ₂ O ⁻	1.1
H ₂ O ⁺	7.8
Volatiles (excl. H ₂ O, CO ₂)	1.6

Raw properties:

Water of plasticity (%): 19.0
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 2.9

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	5.0	17.0	31.2	1.83
982						
1900	Tan	3	5.0	13.6	26.3	1.93
1038						
2000	Tan	3	10.0	11.0	21.6	1.97
1093						
2100	Beige	4	10.0	8.5	17.9	2.10
1149						
2200	Buff	5	10.0	4.8	10.3	2.13
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: 14 (1398°C)
(2548°F)

Bloating test: Negative

Remarks: Low plasticity. Good color at 1900°F.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

BEAVER COUNTY Darlington Twp. New Galilee quad.

Sample number **5-C-18**

Location: Coal stripping operated by the Dodds Coal Company located about 10,000 feet (3050 m) west-northwest of New Galilee and about 800 feet (240 m) west of the intersection of Madden Run, Madden Run Road, and Echo Valley Road.

Latitude: 40°50'25"N

Longitude: 80°26'18"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Entire stratigraphic interval between the Middle and Upper Kittanning coals, consisting of 2.5 feet (0.8 m) of gray underclay beneath the Upper Kittanning coal and 12.5 feet (3.8 m) of gray to medium-gray, silty roof shale below the underclay. Both materials commonly break into hackly or platy fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Composite of 15 stratigraphic feet (5 m)

Chemical analysis:

	%
SiO ₂	52.9
TiO ₂	1.0
Al ₂ O ₃	21.0
Fe ₂ O ₃	1.2
FeO	5.4
MnO	0.10
MgO	1.6
CaO	0.44
Na ₂ O	0.36
K ₂ O	3.2
P ₂ O ₅	0.17
S (total)	0.35
C (org.)	4.0
CO ₂	1.7
H ₂ O ⁻	1.1
H ₂ O ⁺	6.3
Volatiles (excl. H ₂ O, CO ₂)	3.3

Mineralogy (X-ray):

	%
Quartz	13
Mica	59
Kaolinite	24
Chlorite- vermiculite	3
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	19.0
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	4.0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	5.0	21.6	36.3	1.68
982						
1900	Salmon	2	5.0	17.5	31.6	1.80
1038						
2000	Orange tan	3	5.0	13.1	25.4	1.93
1093						
2100	Dark red	3	7.5	11.1	22.4	2.01
1149						
2200	Dark brown	4	10.0	9.1	19.4	2.13
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: 7 (1264°C)
(2307°F)

Bloating test: Positive

Bloating tests (quick-firing):

Crushing characteristics: Platy

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.45	90.5	15.1	Slight laminar expansion.
1038				
2000	1.09	68.0	15.4	Mostly laminar expansion.
1093				
2100	0.88	54.9	16.9	Numerous large pores.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1 inch
(2.5 cm) in diameter

Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1"x1" (2.5x2.5 cm) rod

Pour weight of feed (lb/ft³): 80.0
(kg/m³): 1281.6

Bloating temperature (°F): 2050
(°C): 1121

Logging temperature, nodules sticking together (°F): 2080
(°C): 1138

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size</i> <i>designa-</i> <i>tion</i>	<i>3/4"</i> <i>(1.9</i> <i>cm)</i>	<i>1/2"</i> <i>(1.3</i> <i>cm)</i>	<i>3/8"</i> <i>(.95</i> <i>cm)</i>	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine	--	--	--	--	100.0	50.2	14.5	8.3
Coarse	100.0	62.5	41.4	22.8	18.1	--	--	--

Fine: 56.0

Coarse: 55.0

*ASTM designation C311-59T

Remarks: Promising raw material for lightweight aggregate. May be necessary to pelletize.

Potential uses: Grade SW building brick; Type FBS facing brick; lightweight aggregate.

BEAVER COUNTY Darlington Twp. New Galilee quad.

Sample number **5-C-19**

Location: Coal stripping operated by the Dodds Coal Company located about 10,000 feet (3050 m) west-northwest of New Galilee and about 800 feet (240 m) west of the intersection of Madden Run, Madden Run Road, and Echo Valley Road.

Latitude: 40°50'25''N

Longitude: 80°26'18''W

Geologic unit: Freeport Formation, Allegheny Group

Description: Medium- to dark-gray, silty roof shale overlying the Upper Kittanning coal. Breaks into platy fragments that weather yellow brown in color. Siderite nodules occur within the shale. Medium- to fine-grained sandstone occurs stratigraphically above the shale.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 6 feet (1.8 m) of shale

Chemical analysis:		Mineralogy (X-ray):	
	%		%
SiO ₂	52.7	Quartz	18
TiO ₂	0.85	Mica	66
Al ₂ O ₃	21.1	Kaolinite	10
Fe ₂ O ₃	7.1	Chlorite-	
FeO	2.1	vermiculite	3
MnO	0.06	Feldspar	3
MgO	1.8	Montmorillonite	0
CaO	0.46	Calcite	0
Na ₂ O	0.36		
K ₂ O	3.7		
P ₂ O ₅	0.34		
S (total)	1.2	Raw properties:	
C (org.)	1.0		
CO ₂	0.03		
H ₂ O ⁻	1.2		
H ₂ O ⁺	6.6		
Volatiles			
(excl. H ₂ O, CO ₂)	1.4		
		Water of plasticity (%):	21.0
		Drying shrinkage (%):	5.0
		Workability:	Plastic
		Dry strength:	Good
		Drying defects:	None
		pH:	3.3

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	5.0	18.7	33.8	1.81
982						
1900	Orange tan	3	7.5	13.8	27.1	1.97
1038						
2000	Orange tan	4	7.5	9.1	19.1	2.10
1093						
2100	Dark red	4	10.0	4.7	10.9	2.31
1149						
2200	Dark brown	5	10.0	3.4	7.2	2.13
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2100°C.

Potential uses: Grade SW building brick; Type FBA facing brick; Type H floor brick.

BEAVER COUNTY South Beaver Twp. New Galilee quad.

Sample number 5-C-26

Location: Darlington Brick & Clay Products Company pit (operated by Ralph A. Veon) located south of the North Fork of Little Beaver River, about 8000 feet (2440 m) southwest of Darlington and about 4300 feet (1310 m) west-southwest of the intersection of Pa. Routes 51 and 168.

Latitude: 40°47'47"N**Longitude:** 80°26'58"W**Geologic unit:** Clarion Formation, Allegheny Group

Description: Gray silty underclay to the Lower Kittanning coal. Plant fragments occur throughout the 6 feet (1.8 m) sampled, but are more abundant in the upper 2 feet (0.6 m). Character of sample changes to a clayey sandstone in the lower 0.4 feet (0.1 m) of the sample.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Unweathered**Sampled interval:** Channel sample through 6 feet (1.8 m)**Chemical analysis:****Mineralogy (X-ray):**

	%		%
SiO ₂	62.1	Quartz	30
TiO ₂	1.9	Mica	47
Al ₂ O ₃	22.3	Kaolinite	13
Fe ₂ O ₃	1.3	Chlorite-	
FeO	0.36	vermiculite	2

Chemical analysis:

	%
MnO	0.01
MgO	0.52
CaO	0.38
Na ₂ O	0.11
K ₂ O	1.3
P ₂ O ₅	0.13
S (total)	0.43
C (org.)	0.32
CO ₂	0.06
H ₂ O ⁻	1.4
H ₂ O ⁺	7.2
Volatiles (excl. H ₂ O, CO ₂)	0.30

Mineralogy (X-ray):

	%
Feldspar	6
Montmorillonite	2
Calcite	0

Raw properties:

Water of plasticity (%):	19.2
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	3.6

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Cream	3	10.0	19.4	34.2	1.76
982						
1900	Cream	3	10.0	14.0	26.4	1.88
1038						
2000	Ivory	3	10.0	13.6	26.4	1.94
1093						
2100	Ivory	3	10.0	13.3	26.1	1.96
1149						
2200	Ivory	4	10.0	11.6	23.9	2.06
1204						
2300	Buff	5	10.0	9.8	19.4	1.99
1260						

Pyrometric cone equivalent: 20 (1564°C)
(2847°F)

Bloating test: Negative

Remarks: A stoneware-type clay of good quality.

Potential uses: Grade SW building brick; Type FBX facing brick; low-duty refractory.

BEAVER COUNTY South Beaver Twp. New Galilee quad.

Sample number 5-C-27

Location: Darlington Brick & Clay Products Company pit, operated by Ralph A. Veon, located south of the North Fork of Little Beaver River, about 8000 feet (2440 m) southwest of Darlington and about 4300 feet (1310 m) west-southwest of the intersection of Pa. Routes 51 and 168.

Latitude: 40°47'47"N

Longitude: 80°26'58"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: The sample, collected from 0 to 16.5 feet (0 to 5.0 m) above the Lower Kittanning coal, consists of medium- to medium-dark-gray claystone that contains siderite nodules in eight zones. The nodules range in size from 0.2 x 0.4 feet (0.06 x 0.12 m) to 0.3 x 0.7 feet (0.09 x 0.21 m).

Attitude of bedding: Horizontal

Weathering intensity: Unweathered

Sampled interval: Composite of 16.5 feet (5.0 m) of section

Chemical analysis:

	%
SiO ₂	51.9
TiO ₂	0.91
Al ₂ O ₃	22.4
Fe ₂ O ₃	3.0
FeO	4.7
MnO	0.20
MgO	2.0
CaO	0.54
Na ₂ O	0.24
K ₂ O	3.6
P ₂ O ₅	0.29
S (total)	1.1
C (org.)	0.87
CO ₂	0.04
H ₂ O ⁻	0.92
H ₂ O ⁺	6.8
Volatiles (excl. H ₂ O, CO ₂)	1.5

Mineralogy (X-ray):

	%
Quartz	13
Mica	64
Kaolinite	18
Chlorite- vermiculite	4
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	17.6
Drying shrinkage (%):	0.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	4.2

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Tan	3	5.0	17.0	31.3	1.84
982						
1900	Salmon	3	5.0	11.7	23.4	2.00
1038						
2000	Light brown	3	7.5	7.7	16.9	2.18
1093						
2100	Red brown	4	10.0	7.3	16.1	2.21
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor colors. Low plasticity.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.57	98.0	13.6	No expansion.
1038				
2000	1.31	81.8	17.3	Slight laminar expansion.
1093				
2100	0.90	56.2	24.8	Fair pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1 inch
(2.5 cm) in diameter

Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1"x1" (2.5x2.5 cm) rod

Pour weight of feed (lb/ft³): 88.0(kg/m³): 1409.8

Bloating temperature (°F): 2050

(°C): 1121

Logging temperature, nodules sticking together (°F): 2070

(°C): 1132

Firing data:

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designation</i>	<i>3/4"</i> <i>(1.9 cm)</i>	<i>1/2"</i> <i>(1.3 cm)</i>	<i>3/8"</i> <i>(.95 cm)</i>	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine	--	--	--	--	100.0	51.7	16.6	10.4
Coarse	100.0	79.5	48.7	4.0	1.0	--	--	--

Fine: 40.0

Coarse: 39.0

Remarks: Promising material for lightweight aggregate; may be necessary to pelletize.**Potential uses:** Grade SW building brick; lightweight aggregate.

*ASTM designation C311-59T

BEAVER COUNTY South Beaver Twp. New Galilee quad.Sample number **5-C-28****Location:** Darlington Brick and Clay Products Company pit, operated by Ralph A. Veon, located south of the North Fork of Little Beaver River, about 8000 feet (2440 m) southwest of Darlington and about 4300 feet (1310 m) west-southwest of the intersection of Pa. Routes 51 and 168.**Latitude:** 40°47'47"N**Longitude:** 80°26'58"W**Geologic unit:** Kittanning Formation, Allegheny Group**Description:** Underclay to the Middle Kittanning coal, consisting of medium- to medium-dark-gray silty clay in the upper 4 feet (1.2 m) and nodular clays in the lower 5 feet (1.5 m). Nodules are commonly oolitic in size.**Attitude of bedding:** Horizontal**Weathering intensity:** Unweathered**Sampled interval:** Channel through 9 feet (2.7 m) of underclay**Chemical analysis:****Mineralogy (X-ray):**

	%
SiO ₂	58.6
TiO ₂	1.4
Al ₂ O ₃	23.4
Fe ₂ O ₃	1.5
FeO	1.3
MnO	0.03
MgO	1.2
CaO	0.33

	%
Quartz	26
Mica	48
Kaolinite	21
Chlorite-	
vermiculite	0
Feldspar	2
Montmorillonite	3
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.24
K ₂ O	2.8
P ₂ O ₅	0.10
S (total)	0.25
C (org.)	0.78
CO ₂	0.08
H ₂ O ⁻	2.3
H ₂ O ⁺	5.8
Volatiles (excl. H ₂ O, CO ₂)	0.60

Raw properties:

Water of plasticity (%): 17.6
 Drying shrinkage (%): 0.0
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 4.5

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Peach	2	5.0	16.1	29.6	1.84
982						
1900	Peach	3	5.0	14.0	26.6	1.90
1038						
2000	Tan	3	5.0	12.1	23.9	1.97
1093						
2100	Tan	3	7.5	10.9	22.1	2.03
1149						
2200	Buff	4	7.5	7.8	16.2	2.07
1204						
2300	Buff	5	10.0	5.5	11.4	2.07
1260						

Pyrometric cone equivalent: 14 (1398°C)
(2548°F)

Bloating test: Negative

Remarks: Low plasticity; good color at 2100°F.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

BEAVER COUNTY South Beaver Twp. New Galilee quad.

Sample number **5-C-29**

Location: Strip mine located about 8000 feet (2440 m) due west of Miskita Lake and about 1600 feet (490 m) west-northwest of the intersection of Pa. Routes 168 and 251.

Latitude: 40°45'58"N

Longitude: 80°29'45"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Medium- to light-medium-gray underclay to the Lower Kittanning coal.

Attitude of bedding: Horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 4.7 feet (1.4 m) of underclay

Chemical analysis:

Mineralogy (X-ray):

	%
SiO ₂	55.2
TiO ₂	1.7
Al ₂ O ₃	25.4
Fe ₂ O ₃	2.1
FeO	5.6
MnO	0.01
MgO	0.50
CaO	0.24
Na ₂ O	0.15
K ₂ O	1.4
P ₂ O ₅	0.18
S (total)	0.4
C (org.)	0.52
CO ₂	0.08
H ₂ O ⁻	2.0
H ₂ O ⁺	8.8
Volatiles (excl. H ₂ O, CO ₂)	1.0

	%
Quartz	25
Mica	51
Kaolinite	24
Chlorite- vermiculite	0
Feldspar	0
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%)	22.6
Drying shrinkage (%)	0.0
Workability:	Plastic
Dry strength:	Fair
Drying defects:	None
pH:	2.3

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Peach	2	5.0	18.9	33.3	1.76
982						
1900	Peach	2	5.0	17.7	30.7	1.79
1038						
2000	Tan	3	5.0	16.7	30.6	1.83
1093						
2100	Tan	3	10.0	13.6	26.5	1.94
1149						
2200	Tan	4	10.0	9.8	20.0	2.03
1204						
2300	Buff	5	10.0	7.7	15.8	2.06
1260						

Pyrometric cone equivalent: 26 (1621°C)
(2950°F)

Bloating test: Negative

Remarks: Good color (2200°F).

Potential uses: Grade SW building brick; Type FBS facing brick; low-duty refractories.

BEAVER COUNTY South Beaver Twp. New Galilee quad.Sample number **5-C-30**

Location: Strip mine located about 8000 feet (2440 m) west of Miskita Lake and about 7600 feet (2320 m) west-northwest of the intersection of Pa. Routes 168 and 251.

Latitude: 40°45'58"N

Longitude: 80°29'45"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Semiplastic, medium- to medium-dark-gray, silty underclay to the Middle Kittanning coal. Nodule zone occurs about 4 feet (1.2 m) below the coal; nodules are up to 0.3 x 0.4 feet (0.9 x 0.12 m) in size. Limonite encrustations occur locally in the lower foot of the underclay.

Attitude of bedding: Horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Channel through 9 feet (2.7 m)**Chemical analysis:**

	%
SiO ₂	53.3
TiO ₂	1.4
Al ₂ O ₃	24.4
Fe ₂ O ₃	3.2
FeO	0.80
MnO	0.0
MgO	0.84
CaO	0.20
Na ₂ O	0.22
K ₂ O	2.6
P ₂ O ₅	0.23
S (total)	1.3
C (org.)	1.9
CO ₂	0.08
H ₂ O ⁻	1.5
H ₂ O ⁺	8.5
Volatiles (excl. H ₂ O, CO ₂)	2.0

Mineralogy (X-ray):

	%
Quartz	15
Mica	65
Kaolinite	18
Chlorite- vermiculite	2
Feldspar	0
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	19.0
Drying shrinkage (%):	0.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	2.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Peach	2	5.0	20.7	35.4	1.71
982						
1900	Peach	3	7.5	18.2	32.5	1.78
1038						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2000	Tan	3	7.5	14.7	27.8	1.89
1093						
2100	Tan	3	10.0	10.4	20.9	2.01
1149						
2200	Buff	4	10.0	5.9	12.1	2.05
1204						
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: 16 (1491°C)
(2716°F) Bloating test: Negative

Remarks: Low plasticity; good color (2100°F).

Potential uses: Grade SW building brick; Type FBS facing brick; low-duty refractories.

BEAVER COUNTY North Sewickley Twp. Beaver Falls quad.

Sample number 5-D-6

Location: East side of River Road which is east of and parallel to Beaver River, and about 4200 feet (1280 m) south of Bellton.

Latitude: 40°49'10"N

Longitude: 80°18'41"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Gray to olive-drab, semifissile to thin-bedded silty shale; silt content is greater in the upper half of the sampled section. Several thin (0.6 inch, or 1.5 cm) sandstone beds occur in the upper 6 feet (1.8 m). Shale breaks into fragments that are either splintery, platy, or equant. Fracture surfaces are usually iron stained.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Twelve feet (4 m) of channel sample

Chemical analysis:

Mineralogy (X-ray):

	%		%
SiO ₂	61.1	Quartz	30
TiO ₂	0.94	Mica	53
Al ₂ O ₃	17.0	Kaolinite	7
Fe ₂ O ₃	6.9	Chlorite-	
FeO	1.0	vermiculite	5
MnO	0.12	Feldspar	4
MgO	1.4	Montmorillonite	1
CaO	0.23	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.17
K ₂ O	3.1
P ₂ O ₅	0.20
S (total)	0.08
C (org.)	0.73
CO ₂	0.08
H ₂ O ⁻	1.1
H ₂ O ⁺	5.7
Volatiles (excl. H ₂ O, CO ₂)	0.60

Raw properties:

Water of plasticity (%): 21.1
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 3.9

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	5.0	23.0	38.3	1.67
982						
1900	Tan	2	5.0	18.8	33.3	1.78
1038						
2000	Orange tan	3	10.0	17.4	31.2	1.79
1093						
2100	Light red	4	10.0	13.1	25.7	1.96
1149						
2200	Dark red	5	10.0	9.9	20.3	2.06
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Good color (2200°F). Low plasticity.

Bloating tests (quick-firing):

Crushing characteristics: Platy

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.80	112.4	7.6	No expansion.
1038				
2000	1.51	94.3	8.8	Slight expansion.
1093				
2100	1.03	64.3	8.0	Good pore structure.
1149				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1 inch (2.5 cm) in diameter Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1"x1" (2.5x2.5 cm) rod

Pour weight of feed (lb/ft³): 80.0 Bloating temperature (°F): 2130
(kg/m³): 1281.6 (°C): 1166

Logging temperature, nodules sticking together (°F): 2160
(°C): 1182

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size</i> <i>designa-</i> <i>tion</i>	<i>3/4"</i> <i>(1.9</i> <i>cm)</i>	<i>1/2"</i> <i>(1.3</i> <i>cm)</i>	<i>3/8"</i> <i>(.95</i> <i>cm)</i>	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine	--	--	--	--	100.0	50.8	16.8	11.2
Coarse	100.0	80.0	60.1	33.5	26.7	--	--	--

Fine: 54.0

Coarse: 53.0

Remarks: Promising raw material for lightweight aggregate (may be necessary to pelletize).

Potential uses: Grade SW building brick; Type FBS facing brick; lightweight aggregate.

*ASTM designation C311-59T

BEAVER COUNTY North Sewickley Township Beaver Falls quad.

Sample number 5-D-7

Location: Abandoned strip mine on Collins property, about 2900 feet (880 m)
south of Providence Cemetery.

Latitude: 40°49'14"N

Longitude: 80°15'40"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium-dark-gray, semifissile to thin-bedded shale containing some
intervals of silty shale, especially in the upper 11 feet (3.4 m) of
the section. Eight zones containing siderite nodules occur in the
middle third of the sampled interval. The nodules range from about
0.1 to 0.4 inches (0.3 to 1.0 cm) in long direction. The shale breaks
down into hackly to platy fragments. Interval is stratigraphically
above the Middle Kittanning coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Very slightly

Sampled interval: Channel sample through 21 stratigraphic feet (6 m)

Chemical analysis:

	%
SiO ₂	55.2
TiO ₂	0.88
Al ₂ O ₃	21.0
Fe ₂ O ₃	4.8
FeO	2.8
MnO	0.12
MgO	2.0
CaO	0.3
Na ₂ O	0.36
K ₂ O	3.4
P ₂ O ₅	0.26
S (total)	0.36
C (org.)	1.3
CO ₂	0.08
H ₂ O ⁻	0.9
H ₂ O ⁺	6.3
Volatiles (excl. H ₂ O, CO ₂)	0.8

Mineralogy (X-ray):

	%
Quartz	22
Mica	52
Kaolinite	18
Chlorite-	
vermiculite	5
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	20.0
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	4.9

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	5.0	20.9	36.3	1.74
982						
1900	Tan	2	7.5	16.1	30.4	1.86
1038						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2000	Orange tan	3	10.0	11.4	23.0	2.01
1093						
2100	Light red	4	10.0	7.5	16.4	2.18
1149						
2200	Dark red	5	10.0	4.7	10.4	2.21
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). Low plasticity.

Bloating tests (quick-firing):Crushing characteristics: **Platy**

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	2.01	125.5	6.7	No expansion.
1038				
2000	1.51	94.3	12.2	Slight expansion.
1093				
2100	1.05	65.6	10.7	Good pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		

Raw material:

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-1/2"	+3/8"	--	--
-1.3 cm	+95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1 inch (2.5 cm) in diameter Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1"x1" (2.5x2.5 cm) rod

Pour weight of feed (lb/ft³): 80.0 Bloating temperature (°F): 2160
(kg/m³): 1281.6 (°C): 1182

Logging temperature, nodules sticking together (°F): 2210
(°C): 1210

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designa- tion</i>	<i>3/4" (1.9 cm)</i>	<i>1/2" (1.3 cm)</i>	<i>3/8" (.95 cm)</i>	<i>No. 4</i>	<i>No. 8</i>	<i>No. 16</i>	<i>No. 50</i>	<i>No. 100</i>
Fine	--	--	--	--	100.0	54.8	26.1	20.6
Coarse	100.0	67.9	34.4	2.3	0.4	--	--	--

Fine: 48.0

Coarse: 35.0

Remarks: Promising raw material for lightweight aggregate (may be necessary to pelletize).

Potential uses: Grade SW building brick; Type FBS facing brick; lightweight aggregate.

*ASTM designation C311-59T

BEAVER COUNTY North Sewickley Twp. Beaver Falls quad.

Sample number 5-D-8

Location: Abandoned strip mine on the east side of Chapel Drive, about 1400 feet (430 m) south of its intersection with Harpers Ferry Road.

Latitude: 40°48'18"N

Longitude: 80°15'02"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Dark-gray, semifissile to thin-bedded, silty shale in lower 12 feet (4 m) grading into dark- to medium-brown, thin-bedded, silty,

fine-grained sandstones in upper part of sampled section. A 5-foot- (1.5-m-) thick zone containing siderite nodules occurs from 4 to 9 feet (1.2 to 2.7 m) above the base of the sampled zone. Fragments break into irregular, lense-like or tabular shapes. Interval is stratigraphically above the Middle Kittanning coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Fresh to slightly weathered

Sampled interval: Composite sample through 27 stratigraphic feet (8 m)

Chemical analysis:

	%
SiO ₂	57.5
TiO ₂	0.96
Al ₂ O ₃	19.8
Fe ₂ O ₃	6.3
FeO	1.6
MnO	0.11
MgO	1.9
CaO	0.37
Na ₂ O	0.36
K ₂ O	3.2
P ₂ O ₅	0.21
S (total)	0.05
C (org.)	0.65
CO ₂	0.07
H ₂ O ⁻	1.0
H ₂ O ⁺	5.8
Volatiles (excl. H ₂ O, CO ₂)	0.3

Mineralogy (X-ray):

	%
Quartz	19
Mica	62
Kaolinite	8
Chlorite-	
vermiculite	8
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 22.0
Drying shrinkage (%): 0.0
Workability: Short
Dry strength: Poor
Drying defects: None
pH: 5.2

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	0.0	23.8	39.1	1.64
982						
1900	Tan	2	5.0	17.8	32.5	1.83
1038						
2000	Orange tan	3	5.0	14.4	27.4	1.90
1093						
2100	Dark red	4	10.0	9.8	20.3	2.07
1149						
2200	Red brown	5	10.0	4.6	10.6	2.29
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lump

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.99	124.2	7.07	No expansion.
1038				
2000	1.54	96.1	7.95	Laminar expansion.
1093				
2100	1.41	88.0	5.24	Good pore structure.
1149				
2200	1.24	77.3	5.77	Good pore structure.
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate (heavy).**Potential uses:** Grade SW building brick; Type FBX face brick; Type T floor brick; sewer pipe. Marginal raw material for lightweight aggregate.**BEAVER COUNTY Daugherty Twp. Beaver Falls quad.**

Sample number 5-D-9

Location: Sample collected from ground clay in the storage bin at the abandoned plant of Eastvale (Standard) Clay Products Company, located at the south edge of Eastvale.**Latitude:** 40°45'50"N**Longitude:** 80°18'50"W**Geologic unit:** Kittanning Formation, Allegheny Group**Description:** Ground gray underclay to the Upper Kittanning coal collected from a storage bin.**Chemical analysis:**

	<i>%</i>
SiO ₂	66.0
TiO ₂	1.5
Al ₂ O ₃	20.8
Fe ₂ O ₃	1.0
FeO	0.6
MnO	0.0
MgO	0.57
CaO	0.15

Mineralogy (X-ray):

	<i>%</i>
Quartz	32
Mica	25
Kaolinite	36
Chlorite- vermiculite	0
Feldspar	3
Montmorillonite	4
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.26
K ₂ O	2.2
P ₂ O ₅	0.03
S (total)	0.17
C (org.)	0.44
CO ₂	0.0
H ₂ O ⁻	0.54
H ₂ O ⁺	6.1
Volatiles (excl. H ₂ O, CO ₂)	0.0

Raw properties:

Water of plasticity (%):	18.5
Drying shrinkage (%):	2.5
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	5.7

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Cream	3	5.0	15.4	28.2	1.84
982						
1900	Cream	3	5.0	12.2	23.5	1.93
1038						
2000	Cream	3	5.0	11.6	22.4	1.93
1093						
2100	Tan	4	5.0	10.9	21.5	1.97
1149						
2200	Tan	5	7.5	8.9	18.4	2.07
1204						
2300	Gray	5	10.0	7.6	15.4	2.01
1260						

Pyrometric cone equivalent: 19 (1541°C)
(2806°F) **Bloating test:** Negative

Remarks: A stoneware-type clay of fair quality.

Potential uses: Grade SW building brick; Type FBX facing brick; low-duty refractory.

BEAVER COUNTY North Sewickley Twp. Beaver Falls quad.

Sample number **5-D-10**

Location: Borrow pit on the east side of Pa. Route 65, about 700 feet (210 m) south of the intersection of Pa. Routes 65 and 588. The pit is behind the Fox Den Drive-in Snack Bar.

Latitude: 40°47'18"N

Longitude: 80°17'15"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Alternating gray silty shale and silty claystone, the latter occurring in layers about 0.5 inch (1.3 cm) thick. Silty shale fragments are

usually platy, whereas the claystone breaks into hackly fragments. Tan coloration prevails on weathered surfaces.

Attitude of bedding: Horizontal

Weathering intensity: Unweathered to slightly weathered

Sampled interval: Channel sample through 10 stratigraphic feet (3 m)

Chemical analysis:

	%
SiO ₂	60.5
TiO ₂	0.96
Al ₂ O ₃	16.5
Fe ₂ O ₃	5.5
FeO	3.6
MnO	0.10
MgO	1.9
CaO	0.78
Na ₂ O	0.68
K ₂ O	2.6
P ₂ O ₅	0.22
S (total)	0.05
C (org.)	1.2
CO ₂	1.0
H ₂ O ⁻	0.96
H ₂ O ⁺	4.7
Volatiles (excl. H ₂ O, CO ₂)	0.0

Mineralogy (X-ray):

	%
Quartz	27
Mica	54
Kaolinite	6
Chlorite- vermiculite	7
Feldspar	6
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	22.0
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	5.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	10.0	20.3	35.4	1.74
982						
1900	Tan	3	10.0	15.3	28.6	1.87
1038						
2000	Orange tan	3	15.0	11.8	23.3	1.97
1093						
2100	Dark red	4	15.0	9.3	19.4	2.08
1149						
2200	Red brown	5	15.0	4.8	10.6	2.21
1204						
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Good color (2100°F).

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	2.24	139.8	5.3	No expansion.
1038				
2000	2.03	126.7	2.8	No expansion.
1093				
2100	1.51	94.3	3.0	Fair pore structure.
1149				
2200	0.83	51.8	11.7	Fair pore structure.
1204				
2300	--	--	--	--
1260				

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

Through	Retained on	Weight, percent	Cumulative, percent
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	Sample crushed through 16 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Firing data:

Size range of feed: 1/2"x1" (1.3x2.5 cm) rod

Pour weight of feed (lb/ft³): 81.0 Bloating temperature (°F): 2200
(kg/m³): 1297.6 (°C): 1204Logging temperature, nodules sticking together (°F): 2250
(°C): 1232

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

*ASTM designation C311-59T

Firing data:

<i>Size designa- tion</i>	<i>3/4"</i> <i>(1.9 cm)</i>	<i>1/2"</i> <i>(1.3 cm)</i>	<i>3/8"</i> <i>(.95 cm)</i>	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine	--	--	--	--	--	--	--	--
Coarse	--	100.0	41.3	12.4	9.3	--	2.1	2.1

Fine: Combined

Coarse: 63.0

Remarks: Marginal lightweight aggregate material (heavy and refractory).**Potential uses:** Grade SW building brick; FBX facing brick; Type T floor brick; sewer pipe; marginal lightweight aggregate material.**BEAVER COUNTY North Sewickley Twp. Beaver Falls quad.**Sample number **5-D-11****Location:** Borrow pit on the east side of Pa. Route 65, about 700 feet (210 m) south of the intersection of Pa. Routes 65 and 588. The pit is behind the Fox Den Drive-In Snack Bar.**Latitude:** 40°47'18"N**Longitude:** 80°17'15"W**Geologic unit:** Glenshaw Formation, Conemaugh Group**Description:** Gray silty shale, 2.5 feet (0.76 m) thick, lies stratigraphically above sample 5-D-10. It may be an underclay because it lies directly beneath a thin (0.05 foot, or 0.02 m) black shale which may represent a coal horizon. To the north, the sampled unit appears to pinch out. It weathers to a plastic clay containing shale chips.**Attitude of bedding:** Horizontal**Weathering intensity:** Moderate**Sampled interval:** Channel sample through 2.5 feet (0.8 m)**Chemical analysis:****Mineralogy (X-ray):**

	%		%
SiO ₂	60.1	Quartz	29
TiO ₂	1.0	Mica	50
Al ₂ O ₃	18.0	Kaolinite	15
Fe ₂ O ₃	2.2	Chlorite-	
FeO	4.4	vermiculite	2
MnO	0.16	Feldspar	4
MgO	1.8	Montmorillonite	0
CaO	0.73	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.44
K ₂ O	2.6
P ₂ O ₅	0.11
S (total)	0.23
C (org.)	0.32
CO ₂	2.0
H ₂ O ⁻	1.1
H ₂ O ⁺	5.4
Volatiles (excl. H ₂ O, CO ₂)	0.0

Raw properties:

Water of plasticity (%): 20.5
 Drying shrinkage (%): 5.0
 Workability: Plastic
 Dry strength: Good
 Drying defects: None
 pH: 5.9

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	5.0	16.4	30.4	1.85
982						
1900	Orange tan	3	7.5	12.2	24.3	2.00
1038						
2000	Orange tan	3	10.0	11.5	23.2	2.02
1093						
2100	Light red	4	10.0	8.2	17.4	2.13
1149						
2200	Red brown	6	12.5	3.5	7.9	2.27
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2100°F.

Potential uses: Grade SW building brick; Type FBA facing brick.

BEAVER COUNTY North Sewickley Twp. Beaver Falls quad.Sample number **5-D-12**

Location: Borrow pit on the east side of Pa. Route 65, about 700 feet (210 m) south of the intersection of Pa. Routes 65 and 588. The pit is behind the Fox Den Drive-in Snack Bar.

Latitude: 40°47'18"N**Longitude:** 80°17'15"W**Geologic unit:** Glenshaw Formation, Conemaugh Group

Description: Light- to very dark gray semifissile shale which, upon weathering, changes to a brown to light-tan color. Stratigraphically, this shale

lies directly over sample 5-D-11 and measures 18 feet (5 m) in thickness. Weathering is more pronounced in the upper half of the sampled interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Composite through 18 stratigraphic feet (5 m)

Chemical analysis:

	%
SiO ₂	55.8
TiO ₂	0.97
Al ₂ O ₃	20.6
Fe ₂ O ₃	4.7
FeO	2.4
MnO	0.1
MgO	1.9
CaO	0.32
Na ₂ O	0.6
K ₂ O	3.2
P ₂ O ₅	0.29
S (total)	0.3
C (org.)	1.3
CO ₂	0.08
H ₂ O ⁻	1.3
H ₂ O ⁺	6.4
Volatiles (excl. H ₂ O, CO ₂)	1.0

Mineralogy (X-ray):

	%
Quartz	15
Mica	65
Kaolinite	13
Chlorite- vermiculite	3
Feldspar	4
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	23.0
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	3.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	5.0	22.2	37.5	1.69
982						
1900	Orange tan	2	5.0	16.3	29.7	1.82
1038						
2000	Light red	3	7.5	14.4	27.0	1.87
1093						
2100	Dark red	4	10.0	9.4	19.4	2.06
1149						
2200	Red brown	5	10.0	5.3	11.5	2.18
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). Low plasticity.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	2.00	124.8	8.9	No expansion.
1038				
2000	1.42	88.7	7.1	Slight expansion.
1093				
2100	1.23	76.8	7.2	Fair pore structure.
1149				
2200	1.20	74.8	5.4	Fair pore structure.
1204				
2300	--	--	--	--
1260				

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+95 cm		
-3/8"	+4 mesh	Sample crushed through 16 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Firing data:

Size range of feed: 1/2"x1" (1.3x2.5 cm) rod

Pour weight of feed (lb/ft³): 75.0 Bloating temperature (°F): 2130
(kg/m³): 1201.5 (°C): 1166

Logging temperature, nodules sticking together (°F): 2150
(°C): 1177

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designa- tion</i>	<i>3/4"</i> (1.9 cm)	<i>1/2"</i> (1.3 cm)	<i>3/8"</i> (.95 cm)	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine	--	100.0	55.1	20.3	16.0	--	4.4	4.4
Coarse	--	--	--	--	--	--	--	--

Fine: Combined

Coarse: 39.0

Potential uses: Grade SW building brick; Type FBS facing brick; marginal lightweight aggregate material.

*ASTM designation C311-59T

BEAVER COUNTY North Sewickley Twp. Beaver Falls quad.Sample number **5-D-13**

Location: Borrow pit on the east side of Pa. Route 65, about 700 feet (210 m) south of the intersection of Pa. Routes 65 and 588. The pit is behind the Fox Den Drive-in Snack Bar.

Latitude: 40°47'18"N

Longitude: 80°17'15"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Composite sample of units described under samples 5-D-10, 5-D-11, and 5-D-12. Total stratigraphic interval represented in this sample is 30.5 feet (9.3 m).

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Stratigraphic interval of 30.5 feet (9.3 m)**Chemical analysis:**

	%
SiO ₂	55.8
TiO ₂	0.92
Al ₂ O ₃	20.0
Fe ₂ O ₃	5.4
FeO	2.1
MnO	0.15
MgO	2.0
CaO	0.54
Na ₂ O	0.62
K ₂ O	3.6
P ₂ O ₅	0.22
S (total)	0.13
C (org.)	0.99
CO ₂	0.08
H ₂ O ⁻	1.2
H ₂ O ⁺	6.0
Volatiles (excl. H ₂ O, CO ₂)	1.0

Mineralogy (X-ray):

	%
Quartz	18
Mica	67
Kaolinite	2
Chlorite- vermiculite	6
Feldspar	5
Montmorillonite	2
Calcite	0

Raw properties:

Water of plasticity (%): 21.5
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 4.0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	5.0	22.1	37.3	1.69
982						
1900	Tan	2	7.5	16.9	31.1	1.84
1038						
2000	Orange tan	3	10.0	11.3	22.5	1.99
1093						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2100 1149	Dark red	4	12.5	8.0	17.2	2.14
2200 1204	Dark brown	6	15.0	2.9	6.7	2.33
2300 1260	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Low plasticity. Fair color at 2100°F.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800 982	--	--	--	--
1900 1038	1.47	91.8	20.5	Slight laminar expansion.
2000 1093	1.37	85.5	8.4	Slight laminar expansion.
2100 1149	0.79	49.3	11.6	Fair pore structure.
2200 1204	--	--	--	--
2300 1260	--	--	--	--

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; Type T floor brick; promising lightweight aggregate.

BEAVER COUNTY North Sewickley Twp. Beaver Falls quad.

Sample number 5-D-14

Location: Abandoned pit on the east side of Brighton Road (Pa. Route 65), approximately 500 feet (150 m) northeast of the northeast corner of Locust Grove Cemetery and 1000 feet (300 m) south of the boundary between Beaver and Lawrence Counties.

Latitude: 40°51'02"N

Longitude: 80°17'02"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Dark-gray to black, fissile to thin-bedded shale in the lower 7 feet (2.1 m) of the section grading up into a 10-foot (3-m) interval of moderately weathered, gray brown shale. Interval is stratigraphically in the lower part of the Kittanning Formation. Soil developed over the top of interval sampled.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Composite of 17 stratigraphic feet (5 m)**Chemical analysis:****Mineralogy (X-ray):**

	%
SiO ₂	45.5
TiO ₂	0.97
Al ₂ O ₃	23.2
Fe ₂ O ₃	2.7
FeO	1.2
MnO	0.03
MgO	1.4
CaO	0.43
Na ₂ O	0.24
K ₂ O	2.9
P ₂ O ₅	0.31
S (total)	0.11
C (org.)	12.5
CO ₂	0.05
H ₂ O ⁻	1.3
H ₂ O ⁺	9.4

	%
Quartz	9
Mica	48
Kaolinite	37
Chlorite- vermiculite	2
Feldspar	4
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 17.8
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 4.7

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	Poor bond	5.0	41.7	51.7	1.24
982						
1900	Tan	Poor bond	5.0	29.6	42.7	1.40
1038						
2000	Orange tan	Poor bond	10.0	29.1	41.1	1.41
1093						
2100	Orange tan	Poor bond	10.0	27.6	38.7	1.44
1149						
2200	Buff	Poor bond	10.0	26.7	38.6	1.44
1204						
2300	Buff	3	10.0	26.5	38.4	1.45
1260						

Pyrometric cone equivalent: 10 (1330°C)
 (2426°F)

Bloating test: Negative

Remarks: Low plasticity; poor ceramic bond.

Potential uses: Nonplastic component in structural clay products.

BEAVER COUNTY South Beaver Twp. Midland quad.

Sample number **6-A-7**

Location: Darlington Brick & Clay Products Company shale pit located about 7000 feet (2130 m) northwest of Blackhawk and 1900 feet (580 m) northeast of Salem Church.

Latitude: 40°43'32"N

Longitude: 80°28'35"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium- to dark-gray, thin- to medium-bedded, silty shales grade upward into sandy shales containing an occasional sandstone lense. Siderite nodules measuring from 0.1 to 0.3 foot (0.03 to 0.09 m) in their long dimension and pyrite are scattered throughout the section.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Composite of 50 stratigraphic feet (15 m)

Chemical analysis:

	%
SiO ₂	60.0
TiO ₂	0.96
Al ₂ O ₃	18.8
Fe ₂ O ₃	4.5
FeO	2.4
MnO	0.05
MgO	1.9
CaO	0.39
Na ₂ O	0.63
K ₂ O	3.0
P ₂ O ₅	0.19
S (total)	0.22
C (org.)	1.3
CO ₂	0.08
H ₂ O ⁻	0.84
H ₂ O ⁺	5.4
Volatiles (excl. H ₂ O, CO ₂)	0.0

Mineralogy (X-ray):

	%
Quartz	22
Mica	56
Kaolinite	7
Chlorite- vermiculite	12
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	21.0
Drying shrinkage (%):	0.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	4.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Tan	2	0.0	21.6	36.4	1.68

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1900	Orange tan	3	2.5	20.1	34.9	1.73
1038						
2000	Light brown	3	5.0	14.8	28.6	1.92
1093						
2100	Light red	3	10.0	7.2	15.1	2.11
1149						
2200	Red brown	4	10.0	4.9	10.3	2.12
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color (2100°F).

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe and liner plates.

BEAVER COUNTY Industry Twp. Midland quad.

Sample number 6-A-8

Location: North side of Pa. Route 68 directly under a power line, about 6000 feet (1830 m) southwest of Industry.

Latitude: 40°37'53"N

Longitude: 80°25'51"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Gray underclay to the Lower Kittanning coal containing some plant debris. Upper 0.3 foot (0.1 m) of sampled material is a fissile carbonaceous shale.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel through 5.2 feet (1.6 m) of underclay and shale

Chemical analysis:

Mineralogy (X-ray):

	%		%
SiO ₂	47.9	Quartz	12
TiO ₂	1.0	Mica	69
Al ₂ O ₃	21.9	Kaolinite	16
Fe ₂ O ₃	2.6	Chlorite-	
FeO	1.2	vermiculite	0
MnO	0.01	Feldspar	1
MgO	1.0	Montmorillonite	0
CaO	1.0	Calcite	1
Na ₂ O	0.21	Gypsum	1

Chemical analysis:

	%
K ₂ O	2.8
P ₂ O ₅	0.11
S (total)	1.1
C (org.)	8.8
CO ₂	0.08
H ₂ O ⁻	1.5
H ₂ O ⁺	7.9
Volatiles (excl. H ₂ O, CO ₂)	9.8

Raw properties:

Water of plasticity (%): 17.3
 Drying shrinkage (%): 5.0
 Workability: Plastic
 Dry strength: Good
 Drying defects: None
 pH: 4.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Peach	2	5.0	26.4	40.5	1.53
982						
1900	Peach	2	5.0	23.0	36.8	1.61
1038						
2000	Tan	3	10.0	17.6	30.6	1.74
1093						
2100	Light brown	4	10.0	16.9	30.0	1.77
1149						
2200	Light brown	5	10.0	11.5	20.9	1.82
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: 17 (1512°C)
(1275°F) Bloating test: Negative

Remarks: Fair color (2100°F).

Potential uses: Grade MW building brick; Type FBA facing brick; low-duty refractories.

BEAVER COUNTY Rochester Twp. Beaver quad.

Sample number **6-B-1**

Location: East side of Fosburg Run opposite Lacock School at the end of Oak Avenue in the east end of East Rochester.

Latitude: 40°41'57"N

Longitude: 80°15'53"W

Geologic unit: Allegheny Group

Description: Gray to olive-drab, thin-bedded, silty shale. Breaks into rough, irregular cubes or tabular-shaped fragments. This sample is stratigraphically higher than sample 6-B-2 and is separated from it by 12 feet (4 m) of sandstone.

Attitude of bedding: Horizontal

Weathering intensity: Unweathered

Sampled interval: Composite representing 10 feet (3 m) of shale

Chemical analysis:

	%
SiO ₂	61.8
TiO ₂	1.1
Al ₂ O ₃	17.0
Fe ₂ O ₃	2.1
FeO	4.4
MnO	0.10
MgO	1.5
CaO	0.40
Na ₂ O	0.20
K ₂ O	2.6
P ₂ O ₅	0.18
S (total)	0.08
C (org.)	0.95
CO ₂	1.3
H ₂ O ⁻	0.58
H ₂ O ⁺	5.9
Volatiles (excl. H ₂ O, CO ₂)	0.0

Mineralogy (X-ray):

	%
Quartz	35
Mica	43
Kaolinite	21
Chlorite- vermiculite	0
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	17.4
Drying shrinkage (%):	0.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	4.0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	2	2.5	19.5	34.1	1.75
982						
1900	Beige	3	5.0	17.6	31.7	1.80
1038						
2000	Light red	3	5.0	14.6	27.7	1.89
1093						
2100	Dark red	3	5.0	12.0	23.9	2.00
1149						
2200	Red brown	3	5.0	9.6	19.7	2.05
1204						
2300	Dark brown	4	7.5	3.8	8.6	2.24
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). Low plasticity.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.74	108.6	7.0	No expansion.
1038				
2000	1.34	83.7	13.2	Laminar expansion.
1093				
2100	1.13	70.5	11.7	Fair pore structure.
1149				
2200	1.00	62.4	12.9	Fair pore structure.
1204				
2300	--	--	--	--
1260				

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+95 cm		
-3/8"	+4 mesh	Sample crushed through 16 mesh for disc pelletizing.	
-95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Irregular round pellets

Crushing loss (-4 mesh): None

Firing data:

Size range of feed: -3/4" (1.9 cm) +4 m

Pour weight of feed (lb/ft³): 73.0

Bloating temperature (°F): 2050

(kg/m³): 1169.5

(°C): 1121

Logging temperature, nodules sticking together (°F): 2150

(°C): 1177

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designation</i>	<i>1/2"</i> (1.3 cm)	<i>3/8"</i> (.95 cm)	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine and coarse	100.0	45.4	21.1	18.1	--	6.0	3.0

Fine: Combined

Coarse: 39.0

*ASTM designation C311-59T

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBS facing brick; lightweight aggregate.

BEAVER COUNTY Rochester Twp. Beaver quad.

Sample number **6-B-2**

Location: East side of Fosburg Run opposite Lacock School at the end of Oak Avenue in the east end of East Rochester.

Latitude: 40°41'57"N

Longitude: 80°15'53"W

Geologic unit: Allegheny Group

Description: Gray, fissile to thin-bedded, silty shale containing a coaly shale horizon measuring 0.05 feet (0.02 m) thick at the bottom of the sample. Sample represents 36 stratigraphic feet (11 m). This sample is stratigraphically lower than 6-B-1 and is separated from it by 12 feet (4 m) of sandstone.

Attitude of bedding: Horizontal

Weathering intensity: Unweathered to slightly weathered

Sampled interval: Composite of 36 feet (11 m) of shale

Chemical analysis:

Mineralogy (X-ray):

	%
SiO ₂	60.2
TiO ₂	1.1
Al ₂ O ₃	18.5
Fe ₂ O ₃	5.1
FeO	2.8
MnO	0.10
MgO	1.9
CaO	0.50
Na ₂ O	0.45
K ₂ O	2.8
P ₂ O ₅	0.19
S (total)	0.07
C (org.)	1.1
CO ₂	0.23
H ₂ O ⁻	0.61
H ₂ O ⁺	5.5
Volatiles (excl. H ₂ O, CO ₂)	0.0

	%
Quartz	30
Mica	48
Kaolinite	16
Chlorite- vermiculite	5
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 21.3
Drying shrinkage (%): 0.0
Workability: Short
Dry strength: Poor
Drying defects: None
pH: 5.9

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800 982	Beige	2	0.0	21.9	36.8	1.68
1900 1038	Beige	2	5.0	20.7	35.3	1.71
2000 1093	Light red	3	5.0	17.0	30.8	1.81
2100 1149	Dark red	3	7.5	13.5	26.0	1.93
2200 1204	Red brown	3	10.0	8.5	17.4	2.06
2300 1260	Dark brown	4	10.0	2.7	5.9	2.15

Potential uses: Grade SW building brick; Type FBX facing brick.

Sample number **6-B-3**

Longitude: 80°18'59"W

Geologic unit: Kittanning Formation, Allegheny Group

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Composite representing 11 stratigraphic feet (3.4 m)

Chemical analysis:

Mineralogy (X-ray):

	%	Mineralogy, (wt %)	%
SiO ₂	65.9	Quartz	35
TiO ₂	1.5	Mica	44
Al ₂ O ₃	19.3	Kaolinite	18
Fe ₂ O ₃	1.4	Chlorite-	
FeO	1.3	vermiculite	2

Chemical analysis:

	%
MnO	0.01
MgO	0.74
CaO	0.26
Na ₂ O	0.27
K ₂ O	2.0
P ₂ O ₅	0.06
S (total)	0.34
C (org.)	0.30
CO ₂	0.08
H ₂ O ⁻	0.57
H ₂ O ⁺	5.8

Mineralogy (X-ray):

	%
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	21.0
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Fair
Drying defects:	None
pH:	6.9

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Peach	3	5.0	17.1	31.0	1.81
982						
1900	Peach	3	5.0	16.3	30.0	1.84
1038						
2000	Tan	3	5.0	16.3	30.0	1.84
1093						
2100	Tan	4	5.0	13.1	25.3	1.93
1149						
2200	Tan	4	7.5	10.9	21.6	1.99
1204						
2300	Buff	5	10.0	5.5	11.8	2.15
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2100°F.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

BEAVER COUNTY Fallston Bor. Beaver quad.Sample number **6-B-4**

Location: Colonial Clay Products Company underground mine located about 1000 feet (300 m) south of the intersection of Pa. Route 51 with the railroad crossing to the plant.

Latitude: 40°43'11"N**Longitude:** 80°18'59"W**Geologic unit:** Kittanning Formation, Allegheny Group

Description: Underclay to Upper Kittanning coal. Sample collected along main haulageway about 500 feet (150 m) from the working face. It consists

of a gray, siliceous, plastic clay. Slight amount of iron staining present in the lower 3 feet (0.9 m) of the sampled material which had been below water from about 1948 to 1962.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 8 stratigraphic feet (2.4 m)

Chemical analysis:

	%
SiO ₂	64.4
TiO ₂	1.2
Al ₂ O ₃	19.9
Fe ₂ O ₃	2.3
FeO	0.48
MnO	0.01
MgO	0.85
CaO	0.30
Na ₂ O	0.41
K ₂ O	2.7
P ₂ O ₅	0.09
S (total)	0.52
C (org.)	0.32
CO ₂	0.08
H ₂ O ⁻	0.70
H ₂ O ⁺	5.6
Volatiles (excl. H ₂ O, CO ₂)	1.0

Mineralogy (X-ray):

	%
Quartz	36
Mica	36
Kaolinite	27
Chlorite- vermiculite	0
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	19.2
Drying shrinkage (%):	0.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	3.3

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Peach	2	0.0	18.9	32.6	1.72
982						
1900	Peach	3	5.0	16.9	30.4	1.80
1038						
2000	Tan	3	5.0	14.6	27.3	1.87
1093						
2100	Light brown	4	7.5	10.1	20.0	2.09
1149						
2200	Buff	5	10.0	6.0	12.7	2.10
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color at 2000°F.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

BEAVER COUNTY Fallston Bor. Beaver quad.Sample number **6-B-5**

Location: Colonial Clay Products Company underground mine located about 1000 feet (300 m) south of the intersection of Pa. Route 51 with the railroad crossing to the plant.

Latitude: 40°43'11"N

Longitude: 80°18'59"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Underclay to the Upper Kittanning coal which was collected in a swale about 800 feet (240 m) from the mine entrance. The thickness of the underclay is only 1.3 feet (0.4 m) at this area of the mine due to partial deposition, erosion, or faulting.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Channel sample through 1.3 feet (0.4 m)**Chemical analysis:**

	%
SiO ₂	46.4
TiO ₂	1.4
Al ₂ O ₃	24.1
Fe ₂ O ₃	5.3
FeO	0.76
MnO	0.01
MgO	0.66
CaO	0.55
Na ₂ O	0.62
K ₂ O	1.9
P ₂ O ₅	0.20
S (total)	2.0
C (org.)	1.5
CO ₂	0.02
H ₂ O ⁺	2.4
H ₂ O ⁻	10.5
Volatiles (excl. H ₂ O, CO ₂)	5.0

Mineralogy (X-ray):

	%
Quartz	7
Mica	30
Kaolinite	26
Chlorite- vermiculite	2
Feldspar	0
Montmorillonite	32
Calcite	1
Gypsum	2

Raw properties:

Water of plasticity (%):	17.8
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	Checks
pH:	2.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Pink	3	5.0	21.1	35.5	1.68
982						
1900	Tan	3	5.0	19.7	34.2	1.74
1038						
2000	Light brown	3	10.0	14.4	27.1	1.89
1093						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2100	Light brown	4	12.5	9.6	19.4	2.01
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: 12 (1337°C)
(2439°F) Bloating test: Negative

Potential uses: Not suitable for use in vitreous clay products.

BEAVER COUNTY Fallston Bor. Beaver quad.

Sample number 6-B-6

Location: Colonial Clay Products Company underground mine located about 1000 feet (300 m) south of the intersection of Pa. Route 51 with the railroad crossing to the plant.

Latitude: 40°43'11"N

Longitude: 80°18'59"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Underclay to the Upper Kittanning coal, collected 150 feet (46 m) from the entrance to the mine.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel sample through 5 feet (1.5 m)

Chemical analysis:

	%
SiO ₂	72.1
TiO ₂	1.3
Al ₂ O ₃	15.6
Fe ₂ O ₃	1.9
FeO	0.28
MnO	0.00
MgO	0.42
CaO	0.24
Na ₂ O	0.55
K ₂ O	1.5
P ₂ O ₅	0.04
S (total)	0.27
C (org.)	0.21
CO ₂	0.03
H ₂ O ⁻	0.70
H ₂ O ⁺	4.9
Volatiles	
(excl. H ₂ O, CO ₂)	0.3

Mineralogy (X-ray):

	%
Quartz	39
Mica	33
Kaolinite	28
Chlorite-	
vermiculite	0
Feldspar	0
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 17.5
Drying shrinkage (%): 0.0
Workability: Plastic
Dry strength: Fair
Drying defects: None
pH: 3.8

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Peach	2	5.0	18.4	32.2	1.75
982						
1900	Peach	3	5.0	18.4	32.1	1.75
1038						
2000	Peach	3	5.0	18.1	31.8	1.77
1093						
2100	Tan	4	5.0	17.9	31.8	1.78
1149						
2200	Tan	5	5.0	14.8	27.8	1.89
1204						
2300	Buff	5	5.0	11.7	23.1	1.97
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color (2200°F), might be glazed.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

BEAVER COUNTY Brighton Twp. Beaver quad.

Sample number 6-B-9

Location: Exposure in a ditch for a culvert located about 5200 feet (1580 m) south-southeast of Richmond Union Chapel and 11,400 feet (3470 m) northwest of the school in Vanport, along the southeast side of Pa. Route 60.

Latitude: 40°41'56"N

Longitude: 80°21'50"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Underclay to the Brush Creek coal consisting primarily of gray silty claystone which grades downward into coarse silt and sandy claystone.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Unweathered**Sampled interval:** Channel through 1.6 feet (0.5 m) of underclay**Chemical analysis:****Mineralogy (X-ray):**

	%		%
SiO ₂	62.2	Quartz	29
TiO ₂	1.0	Mica	58
Al ₂ O ₃	18.5	Kaolinite	2
Fe ₂ O ₃	3.7	Chlorite-	
FeO	2.0	vermiculite	3
MnO	0.03	Feldspar	5
MgO	1.4	Montmorillonite	3
CaO	0.33	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.55
K ₂ O	2.7
P ₂ O ₅	0.07
S (total)	0.74
C (org.)	0.50
CO ₂	0.03
H ₂ O ⁻	0.87
H ₂ O ⁺	5.1
Volatiles (excl. H ₂ O, CO ₂)	0.7

Raw properties:

Water of plasticity (%): 18.6
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 4.4

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	2	2.5	18.5	32.9	1.78
982						
1900	Orange tan	3	2.5	17.8	31.8	1.79
1038						
2000	Orange tan	3	2.5	15.1	28.4	1.88
1093						
2100	Light red	3	5.0	11.3	22.7	2.01
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Poor color. Abrupt vitrification (2100–2200°F).**Potential uses:** Grade SW building brick.**BEAVER COUNTY Brighton Twp. Beaver quad.**Sample number **6-B-10**

Location: Exposure in a ditch for a culvert located about 5200 feet (1580 m) south-southeast of the Richmond Union Chapel and 11,400 feet (3470 m) northwest of the school in Vanport, along the southwest side of Pa. Route 60.

Latitude: 40°41'56"N**Longitude:** 80°21'50"W**Geologic unit:** Glenshaw Formation, Conemaugh Group

Description: Medium- to dark-gray, semifissile to thin-bedded shale and slightly silty shale lie stratigraphically above the Brush Creek coal. The darker color is more pronounced in the upper part of the interval, where the carbonaceous content is greater. The shale breaks into platy and equant fragments.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Unweathered

Sampled interval: Composite of 12 stratigraphic feet (4 m)

Chemical analysis:

	%
SiO ₂	58.5
TiO ₂	0.91
Al ₂ O ₃	16.8
Fe ₂ O ₃	3.1
FeO	2.6
MnO	0.07
MgO	1.7
CaO	3.2
Na ₂ O	0.63
K ₂ O	2.7
P ₂ O ₅	0.14
S (total)	1.3
C (org.)	0.86
CO ₂	3.1
H ₂ O ⁻	1.1
H ₂ O ⁺	4.7
Volatiles (excl. H ₂ O, CO ₂)	0.0

Mineralogy (X-ray):

	%
Quartz	28
Mica	51
Kaolinite	17
Chlorite- vermiculite	0
Feldspar	1
Montmorillonite	1
Calcite	2

Raw properties:

Water of plasticity (%):	24.8
Drying shrinkage (%):	2.5
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	7.8

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	2	5.0	15.3	28.4	1.85
982						
1900	Light brown	2	5.0	13.5	26.3	1.94
1038						
2000	Light brown	3	5.0	12.9	25.3	1.96
1093						
2100	Red brown	4	7.5	8.2	13.3	1.63
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor colors. Abrupt vitrification (2100–2200°F).

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)	% Absorb.	Remarks
1800	--	--	--
982			

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1900	1.80	112.6	12.1	No expansion.
1038				
2000	1.57	98.0	15.3	No expansion.
1093				
2100	1.20	74.9	13.5	Fair pore structure.
1149				
2200	0.85	53.0	17.2	Good pore structure.
1204				
2300	--	--	--	--
1260				

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1 inch (2.5 cm) in diameter Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1"x1" (2.5x2.5 cm) rod

Pour weight of feed (lb/ft³): 80.0 Bloating temperature (°F): 2070
(kg/m³): 1281.6 (°C): 1132

Logging temperature, nodules sticking together (°F): 2200
(°C): 1204

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designation</i>	<i>3/4"</i> (1.9 cm)	<i>1/2"</i> (1.3 cm)	<i>3/8"</i> (.95 cm)	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine	--	--	--	--	100.0	44.3	14.0	8.9
Coarse	100.0	58.7	42.7	21.1	15.9	--	--	--

Fine: 55.0

Coarse: 47.0

*ASTM designation C311-59T

Remarks: Promising raw material for lightweight aggregate; may be necessary to pelletize.

Potential uses: Grade SW building brick; lightweight aggregate.

BEAVER COUNTY Brighton Twp. Beaver quad.

Sample number **6-B-18**

Location: Exposure along the north side of Pa. Route 60, about 3000 feet (910 m) northwest of the intersection of Pa. Routes 60 and 68.

Latitude: 40°41'15"N

Longitude: 80°20'33"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Very dark gray, semifissile, silty shale which includes siderite nodules in the upper 4 feet (1.2 m). Siltstone lies stratigraphically above and sandstone below the sampled interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Channel sample through 8.2 feet (2.5 m) of shale

Chemical analysis:

	%
SiO ₂	55.5
TiO ₂	0.96
Al ₂ O ₃	20.4
Fe ₂ O ₃	2.1
FeO	5.0
MnO	0.06
MgO	1.8
CaO	0.94
Na ₂ O	0.22
K ₂ O	3.4
P ₂ O ₅	0.18
S (total)	0.10
C (org.)	0.36
CO ₂	2.1
H ₂ O ⁻	1.0
H ₂ O ⁺	5.6
Volatiles (excl. H ₂ O, CO ₂)	0.0

Mineralogy (X-ray):

	%
Quartz	15
Mica	69
Kaolinite	7
Chlorite- vermiculite	7
Feldspar	1
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%):	16.7
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	7.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Beige	2	5.0	15.3	29.3	1.91

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1900	Tan	3	5.0	12.4	24.7	1.99
1038						
2000	Orange tan	3	5.0	9.6	20.3	2.11
1093						
2100	Light brown	4	10.0	7.2	15.9	2.22
1149						
2200	Dark brown	5	10.0	6.5	14.3	2.20
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Positive

Remarks: Poor colors.

Bloating tests (quick-firing):

Crushing characteristics: Tabular Particle size: -3/4" (1.9 cm) lumps
Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.77	110.5	7.5	No expansion.
1038				
2000	1.61	100.7	10.6	No expansion.
1093				
2100	1.46	91.1	12.8	Laminar expansion.
1149				
2200	1.27	79.3	9.4	Slight expansion.
1204				
2300	0.65	40.0	26.6	Overbloomed, sticky.
1260				

Remarks: Not suitable for use in lightweight aggregate; a mixture of low- and high-temperature bloating materials.

Potential uses: Grade SW building brick.

BEAVER COUNTY Brighton Twp. Beaver quad.

Sample number 6-B-19

Location: Exposure along the north side of Pa. Route 60, about 3000 feet (910 m) northwest of the intersection of Pa. Routes 60 and 68.

Latitude: 40°41'15"N

Longitude: 80°20'33"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Light-medium-gray to medium-gray shale and silty shale underlying a coal seam (Upper Freeport?) which ranges from 0.4 to 0.8 feet (0.1 to 0.2 m) in thickness. Shale breaks into platy fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Channel through 7.5 feet (2.3 m) of shale

Chemical analysis:

	%
SiO ₂	56.0
TiO ₂	1.0
Al ₂ O ₃	22.3
Fe ₂ O ₃	2.4
FeO	3.4
MnO	0.04
MgO	1.8
CaO	0.46
Na ₂ O	0.22
K ₂ O	3.5
P ₂ O ₅	0.10
S (total)	0.10
C (org.)	0.80
CO ₂	0.95
H ₂ O ⁻	0.90
H ₂ O ⁺	6.3
Volatiles (excl. H ₂ O, CO ₂)	0.0

Mineralogy (X-ray):

	%
Quartz	17
Mica	65
Kaolinite	10
Chlorite- vermiculite	5
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	17.5
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	8.0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	2	5.0	15.1	28.4	1.88
982						
1900	Tan	3	5.0	13.8	26.6	1.92
1038						
2000	Orange tan	3	7.5	11.9	23.4	2.00
1093						
2100	Red tan	4	7.5	8.7	18.6	2.13
1149						
2200	Dark brown	5	7.5	6.5	13.9	2.15
1204						
2300	Red brown	6	10.0	3.6	7.9	2.17
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor colors.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	2.11	131.4	6.2	No expansion.
1038				
2000	1.69	105.5	9.1	Slight expansion.
1093				
2100	1.27	79.3	9.9	Slight expansion.
1149				
2200	1.24	77.4	7.3	Slight expansion.
1204				
2300	1.15	72.0	8.2	Slight expansion.
1260				

Potential uses: Grade SW building brick.**BEAVER COUNTY Brighton Twp. Beaver quad.**Sample number **6-B-20****Location:** Exposure along the north side of Pa. Route 60, about 3000 feet (910 m) northwest of the intersection of Pa. Routes 60 and 68.**Latitude:** 40°41'15"N**Longitude:** 80°20'33"W**Geologic unit:** Freeport Formation, Allegheny Group**Description:** Underclay to the Upper Freeport(?) coal that consists of gray silty claystone and breaks into hackly fragments. Lower half of the interval is limy. The overlying coal ranges from 0 to 0.8 foot (0 to 0.2 m) in thickness. Where the coal is absent, a light-tan sandstone overlies the claystone.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Unweathered**Sampled interval:** Channel through 6 feet (1.8 m) of underclay**Chemical analysis:**

	%
SiO ₂	43.9
TiO ₂	0.88
Al ₂ O ₃	16.7
Fe ₂ O ₃	1.3
FeO	13.6
MnO	0.27
MgO	1.8
CaO	2.3

Mineralogy (X-ray):

	%
Quartz	18
Mica	68
Kaolinite	10
Chlorite-	
vermiculite	2
Feldspar	1
Montmorillonite	0
Calcite	1

Chemical analysis:

	%
Na ₂ O	0.13
K ₂ O	2.5
P ₂ O ₅	0.29
S (total)	0.14
C (org.)	0.21
CO ₂	9.5
H ₂ O ⁻	1.3
H ₂ O ⁺	4.6

Raw properties:

Water of plasticity (%):	17.2
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	7.2

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Beige	3	5.0	14.8	28.2	1.91
982						
1900	Tan	3	7.5	13.3	26.3	1.97
1038						
2000	Light brown	4	10.0	11.6	23.6	2.04
1093						
2100	Medium brown	5	10.0	9.9	21.1	2.13
1149						
2200	Dark brown	5	10.0	9.6	20.3	2.12
1204						
2300	Dark brown	6	10.0	2.3	5.4	2.30
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color at 1900°F.

Potential uses: Grade SW building brick; Type FBS facing brick.

BEAVER COUNTY Greene Twp. Hookstown quad.Sample number **6-C-12**

Location: Highwall above the Upper Freeport coal along the west side of Peggs Run, about 8700 feet (2650 m) northeast of Hookstown on property owned by the Peggs Run Coal Company.

Latitude: 40°36'25"N**Longitude:** 80°26'38"W**Geologic unit:** Freeport Formation, Allegheny Group

Description: Gray silty underclay to the Upper Freeport coal. Plant debris is common in the upper 2 feet (0.6 m) of the 4.7 feet (1.4 m) of sampled interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel through 4.7 feet (1.4 m) of underclay

Chemical analysis:

	%
SiO ₂	53.3
TiO ₂	1.1
Al ₂ O ₃	22.3
Fe ₂ O ₃	5.2
FeO	2.2
MnO	0.07
MgO	0.83
CaO	0.40
Na ₂ O	0.20
K ₂ O	2.5
P ₂ O ₅	0.38
S (total)	0.63
C (org.)	0.74
CO ₂	1.1
H ₂ O ⁻	1.6
H ₂ O ⁺	7.2
Volatiles (excl. H ₂ O, CO ₂)	1.2

Mineralogy (X-ray):

	%
Quartz	14
Mica	70
Kaolinite	14
Chlorite- vermiculite	1
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	20.1
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	3.7

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	18.2	32.5	1.78
982						
1900	Salmon	3	7.5	17.9	32.5	1.81
1038						
2000	Light brown	4	7.5	12.8	25.7	2.00
1093						
2100	Light brown	5	10.0	8.6	18.5	2.15
1149						
2200	Medium brown	5	10.0	5.6	11.6	2.09
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: 10 (1330°C) (2426°F) Bloating test: Positive

Remarks: Fair color (2100°F).

Potential uses: Grade SW building brick; Type FBA facing brick.

BEAVER COUNTY Greene Twp. Hookstown quad.Sample number **6-C-13**

Location: Highwall along the west side of Peggs Run, about 8700 feet (2650 m) northeast of Hookstown on property operated by the Peggs Run Coal Company.

Latitude: 40°36'25"N**Longitude:** 80°26'38"W**Geologic unit:** Glenshaw Formation, Conemaugh Group

Description: Medium- to dark-gray, fissile roof shale above the Upper Freeport coal. Thin beds of siltstone are interspersed through the sampled interval. Upper contact of the sample occurs at the contact with an overlying sandstone.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Moderate to severe**Sampled interval:** Channel through 5 feet (1.5 m) of shale**Chemical analysis:**

	%
SiO ₂	59.8
TiO ₂	1.0
Al ₂ O ₃	18.9
Fe ₂ O ₃	1.9
FeO	4.2
MnO	0.10
MgO	1.7
CaO	0.70
Na ₂ O	0.25
K ₂ O	3.1
P ₂ O ₅	0.25
S (total)	0.29
C (org.)	0.24
CO ₂	0.08
H ₂ O ⁻	0.48
H ₂ O ⁺	5.2
Volatiles (excl. H ₂ O, CO ₂)	1.5

Mineralogy (X-ray):

	%
Quartz	26
Mica	37
Kaolinite	32
Chlorite- vermiculite	3
Feldspar	2
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%)	19.2
Drying shrinkage (%)	5.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	4.9

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	2	5.0	18.5	33.3	1.79
982						
1900	Tan	2	5.0	18.2	32.6	1.79
1038						
2000	Light brown	3	5.0	13.5	26.6	1.97
1093						
2100	Red brown	4	5.0	11.5	23.4	2.03
1149						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2200	Dark brown	5	7.5	7.7	16.4	2.12
1204						
2300	Gray brown	5	10.0	2.6	5.6	2.11
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Poor colors.

Potential uses: Grade SW building brick.

BEAVER COUNTY Greene Twp. Hookstown quad.

Sample number **6-C-14**

Location: Highwall along the west side of Peggs Run, about 8700 feet (2650 m) northeast of Hookstown on property operated by the Peggs Run Coal Company.

Latitude: 40°36'25"N

Longitude: 80°26'38"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-gray silty claystone and clayey siltstone from 5.0 to 11.0 feet (1.5 to 3.4 m) above the Upper Freeport coal. Iron staining is common on fragments, which are cube-like in shape.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 6 stratigraphic feet (1.8 m)

Chemical analysis:

	%
SiO ₂	63.4
TiO ₂	1.0
Al ₂ O ₃	16.8
Fe ₂ O ₃	6.8
FeO	0.64
MnO	0.07
MgO	0.82
CaO	0.26
Na ₂ O	0.22
K ₂ O	2.4
P ₂ O ₅	0.14
S (total)	0.25
C (org.)	0.32
CO ₂	0.07
H ₂ O ⁻	1.4
H ₂ O ⁺	5.4

Mineralogy (X-ray):

	%
Quartz	31
Mica	50
Kaolinite	14
Chlorite-	
vermiculite	0
Feldspar	0
Montmorillonite	4
Calcite	1

Raw properties:

Water of plasticity (%):	23.0
Drying shrinkage (%):	2.5
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	4.5

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	2	5.0	18.2	32.6	1.79
982						
1900	Tan	3	5.0	17.2	31.7	1.84
1038						
2000	Orange tan	3	5.0	14.9	28.6	1.92
1093						
2100	Light red	4	5.0	12.4	24.7	1.99
1149						
2200	Dark red	4	7.5	7.6	16.4	2.15
1204						
2300	Red brown	5	10.0	4.0	8.8	2.19
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color (2200°F).

Potential uses: Grade SW building brick; Type FBS facing brick; Type T floor brick; sewer pipe.

BEAVER COUNTY Greene Twp. Hookstown quad.Sample number **6-C-15**

Location: Highwall along the west side of Peggs Run, about 8700 feet (2650 m) northeast of Hookstown on property operated by the Peggs Run Coal Company.

Latitude: 40°36'25"N

Longitude: 80°26'38"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-gray underclay to a rider(?) coal above the Upper Freeport coal. Lower 3 feet (0.9 m) of the 5.7 feet (1.7 m) of underclay is iron stained on fracture surfaces. Siderite nodules are present locally.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 5.7 feet (1.7 m) of underclay

Chemical analysis:

Mineralogy (X-ray):

	%		%
SiO ₂	61.0	Quartz	34
TiO ₂	0.94	Mica	41
Al ₂ O ₃	18.5	Kaolinite	17
Fe ₂ O ₃	4.5	Chlorite-	
FeO	0.60	vermiculite	7
MnO	0.01	Feldspar	1
MgO	1.1	Montmorillonite	0
CaO	0.36	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.31
K ₂ O	2.6
P ₂ O ₅	0.19
S (total)	0.46
C (org.)	1.3
CO ₂	0.02
H ₂ O ⁻	2.1
H ₂ O ⁺	5.9
Volatiles (excl. H ₂ O, CO ₂)	1.7

Raw properties:

Water of plasticity (%):	21.0
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	3.9

Slow-firing tests:

<i>Temp. (°F) (°C)</i>	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Tan	2	5.0	16.7	30.4	1.83
982						
1900	Tan	3	7.5	15.5	28.9	1.87
1038						
2000	Orange tan	3	7.5	11.2	22.5	2.01
1093						
2100	Red tan	4	10.0	8.1	17.5	2.14
1149						
2200	Red brown	5	10.0	5.5	11.9	2.16
1204						
2300	Gray brown	5	10.0	1.4	3.2	2.29
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color (2100°F).

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe.

BEAVER COUNTY Independence Twp. Aliquippa quad.Sample number **6-D-11**

Location: Bluff just east of the southeast corner of a parcel of land owned by the Pennsylvania Game Commission, about 1250 feet (380 m) northwest of the point where Little Traverse Creek enters Raccoon Creek.

Latitude: 40°31'03"N**Longitude:** 80°21'58"W**Geologic unit:** Glenshaw Formation, Conemaugh Group

Description: Gray claystone becoming dark gray and carbonaceous in the upper 0.4 foot (0.1 m). Calcareous zones are common throughout the noncarbonaceous interval. Iron staining is present on fracture surfaces.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel through 5 feet (1.5 m)

Chemical analysis:

	%
SiO ₂	55.5
TiO ₂	0.97
Al ₂ O ₃	18.8
Fe ₂ O ₃	6.4
FeO	0.40
MnO	0.32
MgO	1.6
CaO	2.1
Na ₂ O	0.30
K ₂ O	3.3
P ₂ O ₅	0.56
S (total)	0.03
C (org.)	0.47
CO ₂	0.08
H ₂ O ⁻	2.6
H ₂ O ⁺	5.5
Volatiles (excl. H ₂ O, CO ₂)	0.80

Mineralogy (X-ray):

	%
Quartz	19
Mica	68
Kaolinite	6
Chlorite- vermiculite	2
Feldspar	1
Montmorillonite	3
Calcite	1

Raw properties:

Water of plasticity (%):	23.1
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	8.0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	5.0	14.6	27.6	1.89
982						
1900	Orange tan	3	10.0	11.5	23.5	2.04
1038						
2000	Light brown	4	15.0	5.7	12.9	2.25
1093						
2100	Red brown	5	15.0	2.9	6.5	2.26
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color (2000°F). High shrinkage.

Potential uses: Grade SW building brick; sewer pipe; Type H floor brick.

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800 982	Orange tan	3	2.5	18.2	32.5	1.78
1900 1038	Orange tan	3	2.5	14.9	28.4	1.90
2000 1093	Red tan	4	5.0	8.5	18.0	2.13

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
2100	Red brown	5	7.5	3.5	6.9	1.94
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.45	131.1	17.9	No expansion.
1038				
2000	1.73	108.0	11.1	Slight expansion.
1093				
2100	1.09	68.0	11.9	Good pore structure.
1149				
2200	0.74	46.0	18.5	Overbloated; sticky.
1204				
2300	--	--	--	--
1260				

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1 inch (2.5 cm) in diameter

Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1"x1" (2.5x2.5 cm) rod

Pour weight of feed (lb/ft³): 80.0 Bloating temperature (°F): 2110
(kg/m³): 1281.6 (°C): 1154Logging temperature, nodules sticking together (°F): 2150
(°C): 1177

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designa- tion</i>	<i>3/4"</i> <i>(1.9 cm)</i>	<i>1/2"</i> <i>(1.3 cm)</i>	<i>3/8"</i> <i>(.95 cm)</i>	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine	--	--	--	--	100.0	51.9	18.4	12.1
Coarse	100.0	89.0	72.0	43.0	35.8	--	--	--

Fine: 50.0

Coarse: 44.0

Remarks: Marginal raw material for lightweight aggregate.**Potential uses:** Grade SW building brick; Type FBA facing brick; marginal lightweight aggregate material.

*ASTM designation C311-59T

BEAVER COUNTY Hopewell Twp. Aliquippa quad.Sample number **6-D-22****Location:** Outcrop located about 1.6 miles (2.6 km) north by road from Independence, on the north side of the medium-duty road that is, in general, east of and parallel to Raccoon Creek.**Latitude:** 40°35'14"N**Longitude:** 80°18'24"W**Geologic unit:** Glenshaw Formation, Conemaugh Group**Description:** Light- to medium-gray, thin- to medium-bedded, silty shales that break into tabular- and rectangular-shaped fragments. The lower contact is defined by the occurrence of limestone; the upper contact by siltstone.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Composite of 22 feet (7 m) of shale**Chemical analysis:**

	%
SiO ₂	54.7
TiO ₂	0.97
Al ₂ O ₃	19.5
Fe ₂ O ₃	4.5
FeO	3.9
MnO	0.16
MgO	2.5
CaO	1.1

Mineralogy (X-ray):

	%
Quartz	17
Mica	65
Kaolinite	3
Chlorite-	
vermiculite	10
Feldspar	5
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.80
K ₂ O	2.8
P ₂ O ₅	0.16
S (total)	0.10
C (org.)	0.52
CO ₂	1.0
H ₂ O ⁻	0.79
H ₂ O ⁺	6.2
Volatiles (excl. H ₂ O, CO ₂)	0.0

Raw properties:

Water of plasticity (%): 22.0
 Drying shrinkage (%): 2.5
 Workability: Plastic
 Dry strength: Good
 Drying defects: None
 pH: 7.4

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	2	2.5	17.2	31.3	1.82
982						
1900	Orange tan	3	5.0	14.3	27.5	1.93
1038						
2000	Red tan	4	7.5	7.9	17.0	2.16
1093						
2100	Red brown	5	7.5	0.4	1.1	2.59
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2100°F.

Potential uses: Grade SW building brick; Type L floor brick.

BEAVER COUNTY Center Twp. Aliquippa quad.Sample number **6-D-23**

Location: On a bluff about 900 feet (270 m) west of the intersection of the boundary of Center and Hopewell Townships and Raccoon Creek.

Latitude: 40°36'37"N

Longitude: 80°18'42"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Silty claystones containing lenses of dark-gray carbonaceous claystone in the upper part. Upper 4 feet (1.2 m) of sampled interval consists mainly of brownish-gray, semiplastic, slightly weathered claystones; the lower 5 feet (1.5 m) is olive-gray unweathered claystones that break into small, irregularly shaped cubes.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered to slightly weathered

Sampled interval: Composite of 9 feet (2.7 m) of claystone

Chemical analysis:

	%
SiO ₂	57.0
TiO ₂	1.1
Al ₂ O ₃	22.0
Fe ₂ O ₃	2.9
FeO	0.48
MnO	0.03
MgO	1.2
CaO	1.4
Na ₂ O	0.13
K ₂ O	2.9
P ₂ O ₅	0.05
S (total)	0.05
C (org.)	0.61
CO ₂	0.08
H ₂ O ⁻	2.6
H ₂ O ⁺	6.5
Volatiles (excl. H ₂ O, CO ₂)	1.0

Mineralogy (X-ray):

	%
Quartz	25
Mica	57
Kaolinite	13
Chlorite- vermiculite	0
Feldspar	2
Montmorillonite	2
Calcite	1

Raw properties:

Water of plasticity (%):	20.2
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	7.7

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Tan	3	5.0	15.1	28.4	1.88
982						
1900	Orange tan	4	5.0	12.4	24.5	1.98
1038						
2000	Dark tan	5	7.5	7.2	15.7	2.17
1093						
2100	Light brown	6	10.0	2.9	6.7	2.30
1149						
2200	Dark brown	6	10.0	1.5	3.4	2.31
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: 11 (1336°C)
(2437°F)

Bloating test: Negative

Remarks: Poor colors.

Potential uses: Grade SW building brick.

BEAVER COUNTY Center Twp. Aliquippa quad.

Sample number **6-D-24**

Location: On a bluff about 900 feet (270 m) west of the intersection of the boundary of Center and Hopewell Townships and Raccoon Creek.

Latitude: 40°36'37"N

Longitude: 80°18'42"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-gray to olive, slightly silty claystones that break into irregular blocks. Fractures are commonly conchoidal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Composite of 12 feet (4 m) of claystone

Chemical analysis:

Mineralogy (X-ray):

	%
SiO ₂	61.4
TiO ₂	1.0
Al ₂ O ₃	20.0
Fe ₂ O ₃	4.4
FeO	0.80
MnO	0.03
MgO	0.83
CaO	0.33
Na ₂ O	0.25
K ₂ O	2.1
P ₂ O ₅	0.07
S (total)	0.03
C (org.)	0.16
CO ₂	0.04
H ₂ O ⁻	1.8
H ₂ O ⁺	6.1
Volatiles (excl. H ₂ O, CO ₂)	0.0

	%
Quartz	20
Mica	57
Kaolinite	22
Chlorite- vermiculite	0
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	15.7
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	7.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	5.0	14.5	27.4	1.90
982						
1900	Tan	3	5.0	12.8	25.0	1.96
1038						
2000	Orange tan	4	5.0	9.9	20.5	2.07
1093						
2100	Light brown	5	5.0	6.4	13.9	2.18
1149						
2200	Dark brown	5	7.5	4.3	9.7	2.25
1204						
2300	Gray brown	6	10.0	1.4	3.3	2.37
1260						

Pyrometric cone equivalent: 8 (1300°C)
(2372°F)

Bloating test: Negative

Remarks: Fair color at 2200°F.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe; and Type H floor brick.

BEAVER COUNTY Hopewell Twp. Aliquippa quad.

Sample number **6-D-25**

Location: East side of Pa. Route 60, approximately 1.45 miles (2.3 km) south of the exit to Green Gardens Road.

Latitude: 40°34'57"N

Longitude: 80°17'14"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Red and green-gray silty shales of the Pittsburgh red beds. They break into small, irregular, roughly cube-shaped fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Composite of 50 feet (15 m) of shale

Chemical analysis:

	%
SiO ₂	58.7
TiO ₂	1.0
Al ₂ O ₃	19.3
Fe ₂ O ₃	6.0
FeO	0.40
MnO	0.03
MgO	1.3
CaO	0.72
Na ₂ O	0.12
K ₂ O	2.4
P ₂ O ₅	0.13
S (total)	0.02
C (org.)	0.15
CO ₂	0.02
H ₂ O ⁻	3.4
H ₂ O ⁺	5.9
Volatiles (excl. H ₂ O, CO ₂)	0.0

Mineralogy (X-ray):

	%
Quartz	24
Mica	66
Kaolinite	7
Chlorite- vermiculite	0
Feldspar	1
Montmorillonite	2
Calcite	0

Raw properties:

Water of plasticity (%):	18.6
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	7.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	12.3	24.3	1.97
982						
1900	Orange tan	5	5.0	9.0	19.0	2.11
1038						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2000	Light brown	6	7.5	3.2	7.4	2.33
1093						
2100	Light brown	7	10.0	1.1	2.7	2.38
1149						
2200	Red brown	7	12.5	1.0	2.2	2.33
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2200°F.

Potential uses: Grade SW building brick; sewer pipe; Type M floor brick.

BEAVER COUNTY Marion Twp. Zelienople quad.Sample number **15-C-5**

Location: Borrow pit south of Pa. Route 588 about 2500 feet (760 m) southwest of Fombell and 5000 feet (1520 m) southeast of Goehring.

Latitude: 40°48'09"N

Longitude: 80°12'21"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Gray silty shale containing a few interbeds of shaly siltstone that range in thickness from 0.01 to 0.15 feet (0.3 to 4.6 cm) and contain some pyrite. Shale breaks into equant, platy, or flaggy fragments. Where weathered, the color of the shale is dark tan to brown.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Composite of 12 feet (4 m) of shale

Chemical analysis:

Mineralogy (X-ray):

	%		%
SiO ₂	57.0	Quartz	24
TiO ₂	1.0	Mica	45
Al ₂ O ₃	18.7	Kaolinite	24
Fe ₂ O ₃	2.2	Chlorite-	
FeO	5.8	vermiculite	3
MnO	0.09	Feldspar	4
MgO	2.0	Montmorillonite	0
CaO	0.37	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.60
K ₂ O	3.0
P ₂ O ₅	0.19
S (total)	0.21
C (org.)	1.9
CO ₂	0.08
H ₂ O ⁻	0.56
H ₂ O ⁺	5.6
Volatiles (excl. H ₂ O, CO ₂)	2.0

Raw properties:

Water of plasticity (%): 17.0
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 6.8

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Tan	3	2.5	18.8	32.8	1.74
1900 1038	Tan	3	2.5	16.2	29.7	1.83
2000 1093	Light brown	4	5.0	11.6	23.1	1.99
2100 1149	Red brown	4	5.0	7.6	16.0	2.11
2200 1204	Dark brown	5	5.0	2.7	5.8	2.20
2300 1260	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F).

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800 982	--	--	--	--
1900 1038	1.84	114.8	9.3	No expansion.
2000 1093	1.51	94.2	14.5	No expansion.

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2100 1149	1.12	69.9	10.6	Good pore structure.
2200 1204	0.66	41.0	21.9	Overbloated, sticky.
2300 1260	--	--	--	--

Recommendations: Rotary kiln test recommended for further evaluation.

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1 inch
(2.5 cm) in diameter

Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1"x1" (2.5x2.5 cm) rod

Pour weight of feed (lb/ft³): 89.0 Bloating temperature (°F): 2090
(kg/m³): 1425.8 (°C): 1143

Logging temperature, nodules sticking together (°F): 2100
(°C): 1149

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size</i> <i>designa-</i> <i>tion</i>	<i>3/4"</i> <i>(1.9</i> <i>cm)</i>	<i>1/2"</i> <i>(1.3</i> <i>cm)</i>	<i>3/8"</i> <i>(.95</i> <i>cm)</i>	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine	--	--	--	--	100.0	49.7	16.6	11.1
Coarse	100.0	65.1	46.8	29.1	23.3	--	--	--

Fine: 53.0

Coarse: 45.0

*ASTM designation C311-59T

Remarks: Not suitable for use as lightweight aggregate because material is limy.

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates.

BEAVER COUNTY Franklin Twp. Zelienople quad.

Sample number **15-C-6**

Location: West side of Camp Run Road about 0.15 mile (0.2 km) south of its intersection with Pa. Route 288.

Latitude: 40°49'16"N

Longitude: 80°11'09"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Gray underclay to the Middle Kittanning coal. Top 0.4 feet (0.1 m) of the underclay contains noticeable amounts of carbonaceous material and is colored darker gray.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel through 3 feet (0.9 m) of underclay

Chemical analysis:

	%
SiO ₂	64.7
TiO ₂	1.1
Al ₂ O ₃	18.5
Fe ₂ O ₃	4.6
FeO	0.36
MnO	0.09
MgO	0.64
CaO	0.07
Na ₂ O	0.21
K ₂ O	2.4
P ₂ O ₅	0.10
S (total)	0.10
C (org.)	0.25
CO ₂	0.02
H ₂ O ⁻	0.92
H ₂ O ⁺	5.6
Volatiles (excl. H ₂ O, CO ₂)	0.0

Mineralogy (X-ray):

	%
Quartz	29
Mica	41
Kaolinite	25
Chlorite- vermiculite	0
Feldspar	2
Montmorillonite	3
Calcite	0

Raw properties:

Water of plasticity (%):	22.7
Drying shrinkage (%):	2.5
Workability:	Plastic
Dry strength:	Fair
Drying defects:	None
pH:	3.2

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Tan	3	2.5	20.7	34.8	1.68
1900 1038	Tan	3	5.0	17.1	30.2	1.77

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2000	Dark tan	4	7.5	12.5	23.9	1.92
1093						
2100	Light brown	5	10.0	5.2	11.1	2.15
1149						
2200	Dark brown	6	10.0	2.7	5.9	2.13
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Poor color.

Potential uses: Grade SW building brick; sewer pipe.

BEAVER COUNTY Franklin Twp. Zelienople quad.

Sample number 15-C-7

Location: West side of Camp Run Road about 0.15 mile (0.2 km) south of its intersection with Pa. Route 288.

Latitude: 40°49'16"N

Longitude: 80°11'09"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium- to dark-gray silty shale above the Middle Kittanning coal. Lower 0.6 foot (0.2 m) of sampled interval is carbonaceous shale. Some siderite nodules ranging from 0.2 to 0.3 foot (0.06 to 0.09 m) in long dimension are scattered throughout the section. The shale breaks into lense-shaped and tabular fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Composite of 12 feet (4 m) of shale.

Chemical analysis:**Mineralogy (X-ray):**

	%		%
SiO ₂	55.0	Quartz	17
TiO ₂	0.92	Mica	59
Al ₂ O ₃	20.2	Kaolinite	13
Fe ₂ O ₃	6.8	Chlorite-	
FeO	1.6	vermiculite	10
MnO	0.22	Feldspar	1
MgO	1.7	Montmorillonite	0
CaO	0.30	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.42
K ₂ O	3.2
P ₂ O ₅	0.31
S (total)	0.52
C (org.)	1.0
CO ₂	0.01
H ₂ O ⁻	1.1
H ₂ O ⁺	6.3
Volatiles (excl. H ₂ O, CO ₂)	1.2

Raw properties:

Water of plasticity (%): 20.6
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 7.7

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	2.5	20.9	35.4	1.70
982						
1900	Dark tan	3	5.0	16.6	30.3	1.82
1038						
2000	Light brown	4	7.5	9.7	20.0	2.07
1093						
2100	Dark brown	5	10.0	4.4	9.7	2.22
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor colors.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.59	99.2	11.2	No expansion.
1038				
2000	1.56	97.4	11.6	No expansion.
1093				
2100	1.16	72.4	9.8	Fair pore structure.
1149				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2200	0.67	42.0	15.1	Some large pores.
1204				
2300	--	--	--	--
1260				

Recommendations: Rotary kiln test recommended for further evaluation.

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1 inch (2.5 cm) in diameter Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1"x1" (2.5x2.5 cm) rod

Pour weight of feed (lb/ft³): 86.0 Bloating temperature (°F): 2170
(kg/m³): 1377.7 (°C): 1188

Logging temperature, nodules sticking together (°F): 2190
(°C): 1199

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designa- tion</i>	<i>3/4"</i> (1.9 cm)	<i>1/2"</i> (1.3 cm)	<i>3/8"</i> (.95 cm)	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine	--	--	--	--	100.0	60.0	26.3	18.9
Coarse	100.0	92.9	65.3	40.6	27.1	--	--	--

Fine: 48.0

Coarse: 46.0

Remarks: Promising raw material for lightweight aggregate; may be necessary to pelletize.

Potential uses: Grade SW building brick; lightweight aggregate.

*ASTM designation C311-59T

BUTLER COUNTY Muddy Creek Twp. Portersville quad.Sample number **15-A-8A****Location:** Kerry Coal Company augering operation located in a strip pit about 5,000 feet (1520 m) northwest of Portersville.**Latitude:** 40°55'45"N**Longitude:** 80°09'43"W**Geologic unit:** Kittanning Formation, Allegheny Group**Description:** Olive-black to dark-gray, laminated silty claystones occur above the Middle Kittanning coal. Bedding is poorly defined. Thin siderite bands up to 1 inch (2.5 cm) in thickness are separated by maximum distances of 1 foot (0.3 m) of claystone in some parts of the sampled interval.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Channel sample through 10 feet (3 m) of section above the Middle Kittanning coal**Chemical analysis:****Mineralogy (X-ray):**

	%
SiO ₂	57.2
TiO ₂	0.86
Al ₂ O ₃	19.5
Fe ₂ O ₃	1.8
FeO	5.0
MnO	0.05
MgO	2.2
CaO	0.63
Na ₂ O	0.47
K ₂ O	3.3
P ₂ O ₅	0.26
S (total)	0.34
C (org.)	1.6
CO ₂	0.82
H ₂ O ⁻	0.46
H ₂ O ⁺	5.3
Volatiles (excl. H ₂ O, CO ₂)	1.2

	%
Quartz	18
Mica	60
Kaolinite	11
Chlorite- vermiculite	8
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	16.3
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Good
Drying defects:	None
pH:	7.7

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	17.1	31.8	1.86
982						
1900	Orange tan	3	5.0	14.1	27.5	1.95
1038						
2000	Light brown	4	7.5	8.0	17.6	2.18
1093						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2100	Medium brown	5	10.0	3.1	7.1	2.30
1149						
2200	Dark brown	6	7.5	0.0	0.0	2.25
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F).

Bloating tests (quick-firing):

Crushing characteristics: Tabular Particle size: -3/4" (1.9 cm) lump
Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.79	111.7	11.5	Laminar expansion.
1038				
2000	1.31	81.7	11.7	Slight expansion.
1093				
2100	0.92	57.4	11.8	Good pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBA facing brick; lightweight aggregate.

BUTLER COUNTY Muddy Creek Twp. Portersville quad.

Sample number 15-A-8B

Location: Kerry Coal Company augering operation located in a strip pit about 5,000 feet (1520 m) northwest of Portersville.

Latitude: 40°55'45"N

Longitude: 80°09'43"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium- to medium-dark-gray silty claystones occur from 10 to 20 feet (3 to 6 m) above the Middle Kittanning coal. The claystone breaks down into platy, angular fragments. Minor amount of iron staining occurs along fractures.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample through 10 stratigraphic feet (3 m)

Chemical analysis:

	%
SiO ₂	60.8
TiO ₂	0.98
Al ₂ O ₃	17.8
Fe ₂ O ₃	0.5
FeO	5.0
MnO	0.08
MgO	1.9
CaO	0.9
Na ₂ O	0.8
K ₂ O	2.7
P ₂ O ₅	0.16
S (total)	0.15
C (org.)	0.84
CO ₂	1.5
H ₂ O ⁻	0.34
H ₂ O ⁺	4.5
Volatiles (excl. H ₂ O, CO ₂)	0.96

Mineralogy (X-ray):

	%
Quartz	22
Mica	57
Kaolinite	4
Chlorite- vermiculite	11
Feldspar	6
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	16.5
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	8.2

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	5.0	20.8	35.6	1.71
982						
1900	Orange tan	3	5.0	19.1	33.7	1.76
1038						
2000	Light brown	4	5.0	15.2	28.6	1.88
1093						
2100	Red brown	5	7.5	9.9	20.3	2.05
1149						
2200	Dark brown	5	10.0	3.9	8.8	2.24
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	2.01	125.4	7.3	No expansion.
1038				
2000	1.38	86.1	12.8	Slight expansion.
1093				
2100	0.96	59.9	13.0	Good pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBS facing brick; lightweight aggregate.

BUTLER COUNTY Lancaster Twp. Evans City quad.

Sample number **15-D-9**

Location: Kerry Coal Company strip pit operation located about 6500 feet (1980 m) east of Middle Lancaster.

Latitude: 40°51'22"N

Longitude: 80°06'02"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Olive-gray underclay to the Middle Kittanning coal is partially exposed to show its uppermost 10 inches (25 cm). Plant debris and an occasional show of pyrite occur in the underclay.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel through exposed underclay

Chemical analysis:		Mineralogy (X-ray):	
	<i>%</i>		<i>%</i>
SiO ₂	58.8	Quartz	28
TiO ₂	1.2	Mica	51
Al ₂ O ₃	21.4	Kaolinite	13
Fe ₂ O ₃	2.2	Chlorite-	
FeO	1.3	vermiculite	4

Chemical analysis:

	%
MnO	0.0
MgO	1.3
CaO	0.33
Na ₂ O	0.26
K ₂ O	3.1
P ₂ O ₅	0.05
S (total)	0.9
C (org.)	0.39
CO ₂	0.04
H ₂ O ⁻	1.5
H ₂ O ⁺	6.2
Volatiles (excl. H ₂ O, CO ₂)	0.86

Mineralogy (X-ray):

	%
Feldspar	1
Montmorillonite	0
Calcite	1
Pyrite	1
Goethite	1

Raw properties:

Water of plasticity (%):	14.3
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	7.6

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Tan	3	5.0	12.3	24.7	2.00
982						
1900	Tan	3	5.0	11.3	23.1	2.04
1038						
2000	Orange tan	4	10.0	7.1	15.5	2.18
1093						
2100	Buff	4	10.0	4.0	8.9	2.24
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Might be glazed. No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

BUTLER COUNTY Lancaster Twp. Evans City quad.Sample number **15-D-10**

Location: Kerry Coal Company stripping located east of Little Yellow Creek, about 6500 feet (1980 m) northeast of Middle Lancaster.

Latitude: 40°52'00"N

Longitude: 80°06'24"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Medium- to medium-dark-gray, thin-bedded shaly siltstones occur immediately above the Lower Freeport coal. Beds average 2 inches (5.1 cm) in thickness. Iron staining is common along fracture and bedding planes.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel from 0 to 10 feet (0 to 3 m) above the coal

Chemical analysis:

	%
SiO ₂	58.4
TiO ₂	0.99
Al ₂ O ₃	18.0
Fe ₂ O ₃	2.2
FeO	4.5
MnO	0.08
MgO	1.5
CaO	0.35
Na ₂ O	0.26
K ₂ O	2.7
P ₂ O ₅	0.09
S (total)	0.44
C (org.)	2.1
CO ₂	1.4
H ₂ O ⁻	0.72
H ₂ O ⁺	5.3
Volatiles (excl. H ₂ O, CO ₂)	2.4

Mineralogy (X-ray):

	%
Quartz	26
Mica	52
Kaolinite	13
Chlorite- vermiculite	7
Feldspar	1
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%):	14.9
Drying shrinkage (%):	0.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	7.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	20.0	34.4	1.77
982						
1900	Tan	3	5.0	17.7	32.1	1.81
1038						
2000	Orange tan	4	5.0	14.2	27.6	1.95
1093						
2100	Red brown	5	5.0	11.8	23.7	2.01
1149						
2200	Dark brown	5	10.0	5.9	12.5	2.10
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). No effervescence with HCl.

Bloating tests (quick-firing):Crushing characteristics: **Tabular**Particle size: **-3/4" (1.9 cm) lumps**Retention time: **15 min.**

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.96	122.3	8.0	No expansion.
1038				
2000	1.31	81.7	10.3	Slight expansion.
1093				
2100	1.21	75.5	12.7	Mixed overbloating and non-bloating.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for lightweight aggregate because of mixture of bloating and nonbloating materials.

Potential uses: Grade SW building brick; Type FBS facing brick; drain tile.

BUTLER COUNTY Cranberry Twp. Baden quad.Sample number **16-A-6**

Location: West side of Powell Road at Holly Drive entrance to Forest Park, located about 8300 feet (2530 m) southeast of Wagner Oak Grove Cemetery.

Latitude: 40°42'02"N**Longitude:** 80°08'21"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Olive-gray, slightly silty to silty shales which probably lie somewhere stratigraphically below the Ames limestone. The thicknesses of beds range from 0.05 to 0.2 foot (1.5 to 6.1 cm). The shale breaks into platy or flaggy fragments.

Attitude of bedding: Horizontal

Weathering intensity: Major portion unweathered; upper foot (0.3 m) moderately weathered

Sampled interval: Composite of 20 stratigraphic feet (6 m)

Chemical analysis:

	%
SiO ₂	62.5
TiO ₂	1.0
Al ₂ O ₃	17.2
Fe ₂ O ₃	5.5
FeO	1.3
MnO	0.10
MgO	1.9
CaO	0.40
Na ₂ O	1.1
K ₂ O	2.6
P ₂ O ₅	0.16
S (total)	0.03
C (org.)	0.23
CO ₂	0.01
H ₂ O ⁻	1.3
H ₂ O ⁺	4.6
Volatiles (excl. H ₂ O, CO ₂)	0.0

Mineralogy (X-ray):

	%
Quartz	28
Mica	44
Kaolinite	12
Chlorite- vermiculite	9
Feldspar	7
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%)	20.0
Drying shrinkage (%)	2.5
Workability:	Plastic
Dry strength:	Fair
Drying defects:	None
pH:	7.4

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	15.0	27.8	1.85
982						
1900	Orange tan	4	5.0	7.7	16.4	2.12
1038						
2000	Dark tan	4	7.5	3.8	8.5	2.27
1093						
2100	Red brown	5	10.0	0.5	1.2	2.39
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F).

Bloating tests (quick-firing):

Crushing characteristics:	Angular and tabular	Particle size: -3/4" (1.9 cm) lumps
		Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	2.21	138.0	1.9	No expansion.
1038				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2000	1.99	124.2	5.0	No expansion.
1093				
2100	1.07	66.8	5.9	Very good pore structure.
1149				
2200	0.86	53.7	6.5	Good pore structure.
1204				
2300	--	--	--	--
1260				

Recommendations: Rotary kiln test recommended for further evaluation.

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1 inch (2.5 cm) in diameter Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1"x1" (2.5x2.5 cm) rod

Pour weight of feed (lb/ft³): 76.0 Bloating temperature (°F): 2090
(kg/m³): 1217.5 (°C): 1143

Logging temperature, nodules sticking together (°F): 2160
(°C): 1182

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size</i> <i>designa-</i> <i>tion</i>	<i>3/4"</i> <i>(1.9</i> <i>cm)</i>	<i>1/2"</i> <i>(1.3</i> <i>cm)</i>	<i>3/8"</i> <i>(.95</i> <i>cm)</i>	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine	--	--	--	--	100.0	48.6	17.6	12.2
Coarse	100.0	60.5	40.7	19.0	11.1	--	--	--

Fine: 54.0

Coarse: 46.0

*ASTM designation C311-59T

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; lightweight aggregate.

BUTLER COUNTY Venango Twp. Eau Claire quad.

Sample number 24-B-1A

Location: Lucas Coal Company stripping operation located about 20,000 feet (6100 m) west of Eau Claire.

Latitude: 41°08'27"N

Longitude: 79°52'16"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Olive-gray to brownish-black underclay to the Clarion coal is exposed for a total thickness of 52 inches (132 cm). Plant debris occurs throughout the underclay.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through underclay

Chemical analysis:

	%
SiO ₂	64.7
TiO ₂	1.7
Al ₂ O ₃	19.0
Fe ₂ O ₃	0.97
FeO	0.84
MnO	0.01
MgO	0.64
CaO	0.18
Na ₂ O	0.22
K ₂ O	2.7
P ₂ O ₅	0.05
S (total)	0.45
C (org.)	1.1
CO ₂	0.07
H ₂ O ⁻	0.73
H ₂ O ⁺	5.2
Volatiles (excl. H ₂ O, CO ₂)	1.5

Mineralogy (X-ray):

	%
Quartz	29
Mica	37
Kaolinite	30
Chlorite- vermiculite	0
Feldspar	1
Montmorillonite	3
Calcite	0

Raw properties:

Water of plasticity (%):	15.3
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Good
Drying defects:	None
pH:	6.9

Slow-firing tests:

Temp. (°F) (C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	5.0	16.3	29.9	1.84
982						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1900	Cream	3	5.0	15.7	29.4	1.87
1038						
2000	Cream	4	5.0	14.3	27.4	1.92
1093						
2100	Tan	4	5.0	10.4	21.3	2.05
1149						
2200	Buff	4	10.0	7.3	15.3	2.08
1204						
2300	Gray	6	7.5	4.5	9.7	2.15
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Might be glazed.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile.

BUTLER COUNTY Venango Twp. Eau Claire quad.

Sample number 24-B-1B

Location: Lucas Coal Company stripping operation located about 20,000 feet (6100 m) west of Eau Claire.

Latitude: 41°08'27"N

Longitude: 79°52'16"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Medium-dark-gray claystones occur above the Vanport Limestone. Claystone beds range in thickness from 2 to 9 inches (5.1 to 22.9 cm). Conchoidal fractures are common in the claystone, and iron staining is common along both fractures and bedding.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel through 10 stratigraphic feet (3 m) of claystone

Chemical analysis:

Mineralogy (X-ray):

	%		%
SiO ₂	59.0	Quartz	26
TiO ₂	0.92	Mica	47
Al ₂ O ₃	19.2	Kaolinite	23
Fe ₂ O ₃	2.4	Chlorite-	
FeO	3.4	vermiculite	3
MnO	0.03	Feldspar	1
MgO	1.9	Montmorillonite	0
CaO	0.44	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.23
K ₂ O	3.5
P ₂ O ₅	0.20
S (total)	0.26
C (org.)	1.0
CO ₂	0.38
H ₂ O ⁻	0.63
H ₂ O ⁺	5.4
Volatiles (excl. H ₂ O, CO ₂)	0.97

Raw properties:

Water of plasticity (%): 17.8
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 7.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	2.5	18.2	32.9	1.81
982						
1900	Tan	3	5.0	16.3	30.2	1.86
1038						
2000	Light brown	5	5.0	12.8	25.8	2.02
1093						
2100	Red brown	6	7.5	6.4	13.9	2.18
1149						
2200	Dark brown	6	10.0	2.6	5.9	2.26
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). No effervescence with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	2.07	129.2	6.3	No expansion.
1038				
2000	1.45	90.5	10.4	Slight expansion.
1093				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2100	1.33	83.0	7.8	Slight expansion.
1149				
2200	0.89	55.3	12.6	Good pore structure.
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates; lightweight aggregate.

BUTLER COUNTY Venango Twp. Eau Claire quad.

Sample number **24-B-4A**

Location: Grove City Construction Company stripping located about 8000 feet (2440 m) northwest of Kohlmeyer Corner.

Latitude: 41°09'04"N

Longitude: 79°52'21"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Medium-gray underclay to the Lower Clarion coal or the Brookville coal is partially exposed in the bottom of the stripping. Plant debris occurs in the underclay.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Upper 12 inches (30 cm) of underclay

Chemical analysis:

	<i>%</i>
SiO ₂	67.2
TiO ₂	1.3
Al ₂ O ₃	19.0
Fe ₂ O ₃	0.92
FeO	0.52
MnO	0.00
MgO	0.64
CaO	0.16

Mineralogy (X-ray):

	<i>%</i>
Quartz	42
Mica	44
Kaolinite	7
Chlorite-	
vermiculite	5
Feldspar	2
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.19
K ₂ O	2.6
P ₂ O ₅	0.05
S (total)	0.04
C (org.)	0.08
CO ₂	0.03
H ₂ O ⁻	0.51
H ₂ O ⁺	5.4
Volatiles (excl. H ₂ O, CO ₂)	0.43

Raw properties:

Water of plasticity (%): 16.9
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Good
 Drying defects: None
 pH: 7.4

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	5.0	13.4	25.9	1.94
982						
1900	Cream	3	5.0	12.3	24.4	1.99
1038						
2000	Cream	4	10.0	9.6	19.7	2.07
1093						
2100	Tan	4	10.0	7.1	15.1	2.14
1149						
2200	Tan	4	10.0	6.3	13.6	2.18
1204						
2300	Gray	6	10.0	1.3	3.0	2.30
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: A stoneware-type of clay of fair quality; might be glazed. No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; stoneware.

BUTLER COUNTY Venango Twp. Eau Claire quad.Sample number **24-B-4B**

Location: Grove City Construction Company stripping operation located about 8000 feet (2440 m) northwest of Kohlmeyer Corner.

Latitude: 41°09'04"N

Longitude: 79°52'21"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Underclay to the Upper(?) Clarion coal is exposed for a total thickness of 38 inches (97 cm). The upper 18 inches (46 cm) consists of a severely weathered, yellow-gray clay which is underlain by 20 inches (51 cm) of a moderately weathered, light-medium-gray clay.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate to severe

Sampled interval: Channel through upper 30 inches (76 cm) of underclay

Chemical analysis:

	%
SiO ₂	65.7
TiO ₂	2.0
Al ₂ O ₃	17.1
Fe ₂ O ₃	4.2
FeO	0.16
MnO	0.00
MgO	0.61
CaO	0.27
Na ₂ O	0.22
K ₂ O	2.7
P ₂ O ₅	0.12
S (total)	0.01
C (org.)	0.77
CO ₂	0.04
H ₂ O ⁻	1.1
H ₂ O ⁺	4.9
Volatiles (excl. H ₂ O, CO ₂)	0.40

Mineralogy (X-ray):

	%
Quartz	36
Mica	48
Kaolinite	13
Chlorite- vermiculite	0
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	19.0
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	7.3

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Peach	3	5.0	16.2	30.1	1.86
982						
1900	Peach	3	5.0	14.2	27.2	1.91
1038						
2000	Tan	4	5.0	10.4	21.3	2.05
1093						
2100	Tan	4	10.0	6.5	13.9	2.13
1149						
2200	Light brown	6	10.0	3.3	7.5	2.25
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Might be glazed. No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile.

BUTLER COUNTY Cherry Twp. West Sunbury quad.Sample number **24-C-2A**

Location: Strip pit operated by the Theodore DeMarsh Coal Company located about 1000 feet (300 m) south of Five Points.

Latitude: 41°02'39"N

Longitude: 79°54'30"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium- to medium-dark-gray, plastic underclay to the Middle Kittanning coal is partially exposed in the bottom of the stripping.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Upper foot of underclay**Chemical analysis:**

	%
SiO ₂	56.8
TiO ₂	1.2
Al ₂ O ₃	24.6
Fe ₂ O ₃	2.1
FeO	0.80
MnO	0.0
MgO	1.0
CaO	0.17
Na ₂ O	0.20
K ₂ O	3.1
P ₂ O ₅	0.05
S (total)	0.02
C (org.)	0.75
CO ₂	0.06
H ₂ O ⁻	1.2
H ₂ O ⁺	7.3
Volatiles (excl. H ₂ O, CO ₂)	0.62

Mineralogy (X-ray):

	%
Quartz	24
Mica	48
Kaolinite	25
Chlorite- vermiculite	2
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	17.3
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Fair
Drying defects:	None
pH:	6.3

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Peach	3	5.0	15.6	29.5	1.88
982						
1900	Tan	3	5.0	13.0	25.7	1.97
1038						
2000	Tan	4	5.0	9.5	19.7	2.07
1093						
2100	Tan	6	10.0	5.5	12.1	2.20
1149						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2200	Buff	6.5	10.0	2.7	6.3	2.30
1204						
2300	Gray	7.5	10.0	0.0	0.0	2.32
1260						

Pyrometric cone equivalent: 17 (1512°C)
(2754°F) Bloating test: Negative

Remarks: Might be glazed. No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; low-duty refractories.

BUTLER COUNTY Cherry Twp. West Sunbury quad.

Sample number 24-C-2B

Location: Strip pit operated by the Theodore DeMarsh Coal Company located about 1000 feet (300 m) south of Five Points.

Latitude: 41°02'39"N

Longitude: 79°54'30"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Dark-gray to grayish-black, carbonaceous, slightly silty shale occurs above the Middle Kittanning coal. Beds range in thickness from less than 0.5 inch (1.3 cm) to about 2 inches (5.1 cm). Iron staining is heavy along bedding and fractures. Thickness of unit is greater than 15 feet (5 m).

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel from 0 to 10 feet (0 to 3 m) above coal

Chemical analysis:

	%
SiO ₂	54.1
TiO ₂	0.89
Al ₂ O ₃	20.6
Fe ₂ O ₃	5.6
FeO	2.6
MnO	0.03
MgO	1.5
CaO	0.15

Mineralogy (X-ray):

	%
Quartz	15
Mica	65
Kaolinite	16
Chlorite- vermiculite	3
Feldspar	1
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.20
K ₂ O	3.6
P ₂ O ₅	0.15
S (total)	0.10
C (org.)	1.8
CO ₂	0.35
H ₂ O ⁻	0.96
H ₂ O ⁺	8.8
Volatiles (excl. H ₂ O, CO ₂)	0.0

Raw properties:

Water of plasticity (%):	19.4
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	6.2

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	19.9	35.4	1.78
982						
1900	Orange tan	3	5.0	15.9	30.3	1.91
1038						
2000	Orange tan	4	10.0	11.6	23.6	2.04
1093						
2100	Red brown	4	10.0	7.0	15.4	2.18
1149						
2200	Dark brown	6.5	10.0	2.8	6.6	2.30
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). No effervescence with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.73	108.0	8.1	No expansion.
1038				
2000	1.49	93.0	9.5	No expansion.
1093				

Bloating tests (quick-firing):

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
2100	1.12	69.9	15.6	Mixed overbloomed and non-
1149				bloomed.
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for lightweight aggregate because it consists of a mixture of overbloomed and nonbloomed materials.

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates.

BUTLER COUNTY Cherry Twp. West Sunbury quad.

Sample number **24-C-3**

Location: Stripping operated by the Sunbeam Coal Company located about 4000 feet (1220 m) south-southeast of Five Points.

Latitude: 41°02'12"N

Longitude: 79°54'06"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium- to medium-dark-gray, carbonaceous silty shale occurs above the Middle Kittanning coal for an estimated distance of 40 feet (12 m). Fragments are platy and have angular edges. Iron staining is moderately heavy along bedding and joints. Beds range in thickness from 2 to 6 inches (5.1 to 15.2 cm).

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel from 10 to 20 feet (3 to 6 m) above coal

Chemical analysis:

	%
SiO ₂	56.6
TiO ₂	0.94
Al ₂ O ₃	17.6
Fe ₂ O ₃	2.8
FeO	4.6
MnO	0.09
MgO	1.6
CaO	0.45

Mineralogy (X-ray):

	%
Quartz	20
Mica	69
Kaolinite	3
Chlorite-	
vermiculite	7
Feldspar	1
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.20
K ₂ O	3.1
P ₂ O ₅	0.17
S (total)	0.66
C (org.)	3.2
CO ₂	1.3
H ₂ O ⁻	0.78
H ₂ O ⁺	5.0
Volatiles (excl. H ₂ O, CO ₂)	3.4

Raw properties:

Water of plasticity (%): 18.2
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 6.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	21.9	36.8	1.68
982						
1900	Orange tan	3	5.0	20.6	36.1	1.75
1038						
2000	Light brown	3	5.0	19.0	33.3	1.76
1093						
2100	Red brown	4	7.5	15.5	28.2	1.82
1149						
2200	Dark brown	6	5.0	13.9	24.4	1.76
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). Abrupt vitrification (2200–2300°F).

Bloating tests (quick-firing):

Crushing characteristics: Angular and tabular

Particle size: -3/4" (1.9 cm) lump

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.80	112.3	7.4	No expansion.
1038				
2000	1.16	72.4	12.4	Mixed bloated and non-bloated.
1093				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2100	0.85	53.0	12.0	Mixed overbloomed and bloated.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for lightweight aggregate because of mixed bloated and nonbloated materials.

Potential uses: Grade MW building brick; Type FBS facing brick.

BUTLER COUNTY Allegheny Twp. Emlenton quad.

Sample number **34-A-10A**

Location: Black Fox Mining & Development Company strip pit located about 6000 feet (1830 m) west-southwest of Foxburg.

Latitude: 41°08'19"N

Longitude: 79°42'10"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Medium-light-gray to medium-gray underclay to the Upper Clarion coal is exposed in the strip pit. The underclay is 48 inches (122 cm) thick. The lower 10 inches (25 cm) contains small amounts of mica. Some iron staining is present. The underclay breaks into angular, hackly fragments and is relatively hard to break.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel sample of entire underclay

Chemical analysis:

	<i>%</i>
SiO ₂	70.9
TiO ₂	1.5
Al ₂ O ₃	15.1
Fe ₂ O ₃	1.8
FeO	0.40
MnO	0.0
MgO	0.51
CaO	0.12

Mineralogy (X-ray):

	<i>%</i>
Quartz	51
Mica	17
Kaolinite	31
Chlorite-	
vermiculite	0
Feldspar	1
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.13
K ₂ O	1.8
P ₂ O ₅	0.04
S (total)	0.73
C (org.)	0.35
CO ₂	0.08
H ₂ O ⁻	0.68
H ₂ O ⁺	4.6
Volatiles (excl. H ₂ O, CO ₂)	0.87

Raw properties:

Water of plasticity (%): 20.5
 Drying shrinkage (%): 5.0
 Workability: Plastic
 Dry strength: Good
 Drying defects: None
 pH: 4.9

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Peach	3	5.0	18.7	33.3	1.79
982						
1900	Peach	4	5.0	18.7	33.3	1.79
1038						
2000	Peach	4	5.0	16.3	30.1	1.84
1093						
2100	Tan	4	5.0	13.9	26.3	1.89
1149						
2200	Buff	4	7.5	10.3	20.8	2.01
1204						
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color (2200°F). Might be glazed. No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

BUTLER COUNTY Allegheny Twp. Emlenton quad.Sample number **34-A-10B**

Location: Black Fox Mining and Development Company strip pit located about 6000 feet (1830 m) west-southwest of Foxburg.

Latitude: 41°08'19"N

Longitude: 79°42'10"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Predominantly olive-gray but partly greenish-gray, thin-bedded, slightly silty shales occur from 2 to about 22 feet (0.6 to 7 m) above the Upper Clarion coal. Beds average less than an inch (2.5 cm) in thickness. Shales break down into angular, platy fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through lower 10 stratigraphic feet (3 m)

Chemical analysis:

	%
SiO ₂	58.9
TiO ₂	0.91
Al ₂ O ₃	20.0
Fe ₂ O ₃	3.1
FeO	2.6
MnO	0.04
MgO	1.8
CaO	0.37
Na ₂ O	0.18
K ₂ O	3.5
P ₂ O ₅	0.21
S (total)	0.21
C (org.)	0.83
CO ₂	0.05
H ₂ O ⁻	0.72
H ₂ O ⁺	5.8
Volatiles (excl. H ₂ O, CO ₂)	0.65

Mineralogy (X-ray):

	%
Quartz	23
Mica	51
Kaolinite	18
Chlorite- vermiculite	7
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	21.3
Drying shrinkage (%):	0.0
Workability:	Plastic
Dry strength:	Fair
Drying defects:	None
pH:	6.4

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	0.0	19.7	34.9	1.77
982						
1900	Tan	4	2.5	17.4	32.1	1.85
1038						
2000	Light brown	4	7.5	9.5	20.0	2.10
1093						
2100	Red brown	5	10.0	5.5	12.1	2.21
1149						
2200	Dark brown	6	10.0	0.0	0.0	2.29
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). No effervescence with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.71	106.7	9.8	No expansion.
1093				
2100	0.96	59.9	11.9	Fair pore structure.
1149				
2200	0.92	57.4	7.2	Good pore structure.
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate (may be a mixture).

Potential uses: Grade SW building brick; Type FBA facing brick; lightweight aggregate.

BUTLER COUNTY Allegheny Twp. Emlenton quad.

Sample number 34-A-11A

Location: Black Fox Mining and Development Company strip pit located about 5500 feet (1680 m) southwest of Foxburg.

Latitude: 41°07'52"N

Longitude: 79°41'34"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Dark-gray to brownish-black, carbonaceous, slightly silty, thin-bedded shales occur from 0 to 9 feet (0 to 2.7 m) above the Upper Clarion coal. Thin veinlets of pyrite are present in the lower part of the shale interval and an estimated 2 percent of the interval is made up of siderite nodules.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample from 0 to 9 feet (0 to 2.7 m) above coal

Chemical analysis:**Mineralogy (X-ray):**

	<i>%</i>		<i>%</i>
SiO ₂	52.4	Quartz	14
TiO ₂	0.83	Mica	57
Al ₂ O ₃	20.5	Kaolinite	18
Fe ₂ O ₃	3.6	Chlorite-	
FeO	3.7	vermiculite	3

Chemical analysis:

	%
MnO	0.12
MgO	2.0
CaO	1.1
Na ₂ O	0.19
K ₂ O	3.5
P ₂ O ₅	0.19
S (total)	2.1
C (org.)	0.83
CO ₂	1.6
H ₂ O ⁻	1.1
H ₂ O ⁺	6.8
Volatiles (excl. H ₂ O, CO ₂)	1.2

Mineralogy (X-ray):

	%
Feldspar	1
Montmorillonite	0
Calcite	0
Pyrite	3
Siderite	3
Gypsum present	
Pyrophyllite present	

Raw properties:

Water of plasticity (%):	15.4
Drying shrinkage (%):	0.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	6.8

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	4	5.0	13.9	27.5	1.98
982						
1900	Beige	4	5.0	10.9	22.7	2.08
1038						
2000	Brown	4	10.0	5.0	11.6	2.30
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (1800°F). No effervescence with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.32	82.4	12.8	Slight laminar expansion.
1093				
2100	0.88	54.9	14.6	Fair pore structure.
1149				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2200	0.79	49.3	21.1	Good pore structure.
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate (may be a mixture).

Potential uses: Grade SW building brick; Type FBS facing brick; lightweight aggregate.

BUTLER COUNTY Allegheny Twp. Emlenton quad.

Sample number **34-A-11B**

Location: Black Fox Mining and Development Company strip pit located about 5500 feet (1680 m) southwest of Foxburg.

Latitude: 41°07'52"N

Longitude: 79°41'34"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Medium-gray to medium-dark-gray, thin-bedded, silty claystones occur immediately above the Vanport Limestone. Some iron staining is present along fractures and bedding.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample from 0 to 10 feet (0 to 3 m) above the Vanport Limestone

Chemical analysis:

	<i>%</i>
SiO ₂	58.3
TiO ₂	0.89
Al ₂ O ₃	19.9
Fe ₂ O ₃	1.7
FeO	4.2
MnO	0.04
MgO	1.8
CaO	0.62
Na ₂ O	0.23
K ₂ O	3.4

Mineralogy (X-ray):

	<i>%</i>
Quartz	30
Mica	53
Kaolinite	5
Chlorite-vermiculite	7
Feldspar	5
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
P ₂ O ₅	0.18
S (total)	0.35
C (org.)	0.98
CO ₂	1.0
H ₂ O ⁻	0.57
H ₂ O ⁺	5.4
Volatiles (excl. H ₂ O, CO ₂)	0.60

Raw properties:

Water of plasticity (%): 15.6
 Drying shrinkage (%): 0.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 7.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	3	5.0	18.6	33.9	1.82
982						
1900	Beige	4	5.0	14.6	28.0	1.93
1038						
2000	Light brown	6	7.5	9.4	19.7	2.11
1093						
2100	Dark brown	6	10.0	4.5	10.0	2.24
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (1900°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.43	89.2	12.1	Slight laminar expansion.
1093				
2100	1.15	71.7	13.8	Fair pore structure.
1149				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2200	0.63	39.3	31.6	Overbloated and sticky.
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate (short range).

Potential uses: Grade SW building brick; Type FBS facing brick; Type H floor brick.

BUTLER COUNTY Allegheny Twp. Emlenton quad.

Sample number **34-A-11C**

Location: Black Fox Mining & Development Company strip pit located about 5500 feet (1680 m) southwest of Foxburg.

Latitude: 41°07'52"N

Longitude: 79°41'34"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Olive-gray underclay to the Upper Clarion coal is partially exposed where a small subsidence occurred in the pit. The basal contact of the underclay was not exposed and hence its total thickness was not established. Plant debris was moderately abundant in the sampled interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel through 26 inches (66 cm) of underclay

Chemical analysis:

	<i>%</i>
SiO ₂	73.7
TiO ₂	1.3
Al ₂ O ₃	14.5
Fe ₂ O ₃	0.97
FeO	0.48
MnO	0.00
MgO	0.44
CaO	0.13

Mineralogy (X-ray):

	<i>%</i>
Quartz	50
Mica	28
Kaolinite	21
Chlorite- vermiculite	0
Feldspar	1
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.16
K ₂ O	2.0
P ₂ O ₅	0.03
S (total)	0.38
C (org.)	1.0
CO ₂	0.04
H ₂ O ⁻	0.42
H ₂ O ⁺	3.8
Volatiles (excl. H ₂ O, CO ₂)	1.1

Raw properties:

Water of plasticity (%):	15.8
Drying shrinkage (%):	0.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	6.4

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	0.0	18.7	32.6	1.73
982						
1900	Cream	3	2.5	18.5	31.9	1.74
1038						
2000	Cream	4	5.0	17.5	31.4	1.79
1093						
2100	Ivory	4	5.0	15.3	28.0	1.83
1149						
2200	Ivory	4	5.0	13.8	26.3	1.90
1204						
2300	Buff	6	5.0	8.6	17.3	2.03
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color. Might be glazed. No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; stoneware.

BUTLER COUNTY Allegheny Twp. Emlenton quad.

Sample number 34-A-12

Location: W. A. Cotterman strip pit located about 7500 feet (2290 m) southwest of Foxburg.

Latitude: 41°07'34"N

Longitude: 79°41'45"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Olive-gray, greenish-gray to brownish-black, thin-bedded silty shale occurs from 0 to 6 feet (0 to 1.8 m) above the Lower Kittanning coal. Thicknesses of beds do not exceed 3 inches (7.6 cm). Iron staining is common along bedding planes and fractures. Sandstone occurs stratigraphically above the sampled interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample from 0 to 6 feet (0 to 1.8 m) above the Lower Kittanning coal

Chemical analysis:

	%
SiO ₂	53.9
TiO ₂	0.83
Al ₂ O ₃	21.0
Fe ₂ O ₃	2.3
FeO	5.4
MnO	0.07
MgO	2.2
CaO	0.32
Na ₂ O	0.18
K ₂ O	4.0
P ₂ O ₅	0.14
S (total)	0.44
C (org.)	0.95
CO ₂	0.02
H ₂ O ⁻	0.92
H ₂ O ⁺	5.9
Volatiles (excl. H ₂ O, CO ₂)	1.3

Mineralogy (X-ray):

	%
Quartz	19
Mica	53
Kaolinite	25
Chlorite- vermiculite	0
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	17.0
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	8.0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	15.8	29.6	1.88
982						
1900	Orange tan	4	7.5	11.9	24.0	2.01
1038						
2000	Light brown	4	10.0	6.6	14.9	2.25
1093						
2100	Red brown	6	10.0	3.4	7.8	2.30
1149						
2200	Dark brown	6	10.0	2.0	4.6	2.31
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair colors (2100°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.31	81.7	8.4	Slight expansion.
1038				
2000	1.07	66.8	13.8	Laminar expansion.
1093				
2100	0.64	39.9	11.6	Good pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.**Potential uses:** Grade SW building brick; Type FBA facing brick; sewer pipe; lightweight aggregate.**CAMBRIA COUNTY Spangler Bor. Barnesboro quad.**

Sample number 66-B-3

Location: Exposure on south side of Pa. Route 271, about 700 feet (210 m) south of the athletic field in Spangler.**Latitude:** 40°38'36"N**Longitude:** 78°46'47"W**Geologic unit:** Freeport Formation, Allegheny Group**Description:** Olive-gray, noncalcareous underclay of the Lower Freeport(?) coal is partially exposed for a 24-inch (61-cm) interval below a 29-inch (74-cm) "bony" coal. Sandstone is present above the coal. Some iron staining is present along fractures in the underclay.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Channel sample through 24 inches (61 cm) of underclay**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	61.90	Quartz	31	Water of plasticity (%): 19.2
TiO ₂	1.10	Mica	48	Drying shrinkage (%): 5.0
Al ₂ O ₃	21.50	Kaolinite	19	Workability: Plastic
Fe ₂ O ₃	2.40	Chlorite-		Dry strength: Good
MnO	0.033	vermiculite	0	Drying defects: None
MgO	0.97	Feldspar	1	pH: 7.1

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	0.40	Montmo-	
Na ₂ O	0.19	rillonite	0
K ₂ O	3.20	Calcite	1

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Pale orange yellow	3	5.0	14.1	26.4	1.88
982	(7.5YR8/4)					
1900	Pale orange yellow	3	7.5	11.9	23.5	1.97
1038	(7.5YR8/4)					
2000	Pale to light orange	6	7.5	11.2	22.1	1.98
1093	yellow (7.5YR8/6)					
2100	Pale to light orange	7	7.5	8.5	17.8	2.10
1149	yellow (7.5YR8/6)					
2200	Light yellowish brown	7	10.0	0.7	1.7	2.36
1204	(10YR7/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Abrupt vitrification (2100–2200°F). No effervescence when treated with hydrochloric acid

Potential uses: Grade SW building brick; structural tile (load-bearing).

*Munsell designation

CAMBRIA COUNTY Barr Twp. Colver quad.

Sample number 66-D-4

Location: Exposure on the north side of Pa. Route 553, about 13,000 feet (3960 m) southeast of the village of Nicktown.

Latitude: 40°35'33"N

Longitude: 78°45'47"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Light-olive-gray noncalcareous interbedded shales and silty shales are exposed in a road bank. Thickest beds consist of silty shale and measure up to 2-1/2 inches (6.4 cm). Rock material breaks into small platy fragments, commonly up to about 2 inches (5 cm) in their long dimension. Interiors of weathered fragments are moderate yellow brown to light olive brown in color.

Attitude of bedding: Horizontal; measured zero-degree dip on bedding

Weathering intensity: Slight to moderate

Sampled interval: Channel through 8 stratigraphic feet (2.4 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	57.60	Quartz	23	Water of plasticity (%): 19.0
TiO ₂	0.93	Mica	55	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.90	Kaolinite	11	Workability: Short
Fe ₂ O ₃	8.58	Chlorite-		Dry strength: Fair
MnO	0.05	vermiculite	2	Drying defects: None
MgO	2.02	Feldspar	6	pH: 6.8
CaO	0.30	Montmo-		
Na ₂ O	0.65	rillonite	3	
K ₂ O	3.23	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color*</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Moderate orange	3	5.0	17.0	31.2	1.83
982	(5YR7/8)					
1900	Moderate orange	3	7.5	14.8	28.3	1.92
1038	(2.5YR6/8)					
2000	Brownish orange	3	7.5	10.1	21.1	2.09
1093	(2.5YR5/8)					
2100	Brownish orange	4	7.5	8.9	19.1	2.14
1149	(2.5YR5/8)					
2200	Moderate reddish	8	10.0	2.1	4.9	2.34
1204	brown (2.5YR4/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2200-2300°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

CAMBRIA COUNTY Jackson Twp. Vintondale quad.

Sample number **67-A-4A**

Location: Stripping operated by the Ace Drilling Coal Company, Inc., located north of the village of Chickaree.

Latitude: 40°27'36"N

Longitude: 78°52'32"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium- to dark-gray claystones grading upward to thin-bedded silty shales occur above the Lower Kittanning coal for an interval of 5 feet (1.5 m). Thin-bedded shales range from $< 1/2$ to 2 inches (< 1.3 to 5.1 cm) in thickness. Fragments are commonly chippy to slabby; a few are hackly or rubbly. Dilute hydrochloric acid test shows material to be noncalcareous. Sandstone occurs directly above sampled interval.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Channel sample through 5 stratigraphic feet (1.5 m)**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	59.40	Quartz	15	Water of plasticity (%): 22.3
TiO ₂	1.00	Mica	66	Drying shrinkage (%): 5.0
Al ₂ O ₃	21.45	Kaolinite	18	Workability: Plastic
Fe ₂ O ₃	6.32	Chlorite-		Dry strength: Good
MnO	0.014	vermiculite	0	Drying defects: None
MgO	0.88	Feldspar	1	pH: 5.5
CaO	0.06	Montmo-		
Na ₂ O	0.22	rillonite	0	
K ₂ O	3.93	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light to mod. orange	2	5.0	21.5	35.8	1.67
982	yellow (7.5YR8/6)					
1900	Light to mod. orange	2	5.0	19.8	34.0	1.71
1038	yellow (7.5YR8/6)					
2000	Light to mod. orange	2	7.5	15.1	28.0	1.86
1093	yellow (7.5YR8/6)					
2100	Moderate orange	3	7.5	12.7	24.5	1.94
1149	(5YR7/6)					
2200	Light reddish brown	8	12.5	2.8	6.3	2.27
1204	(2.5YR5/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: Too soft. Abrupt vitrification (2200-2300°F). No effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

CAMBRIA COUNTY Jackson Twp. Vintondale quad.Sample number **67-A-4B****Location:** Stripping operation by Ace Drilling Coal Company Incorporated, located north of the village of Chickaree.**Latitude:** 40°27'36"N**Longitude:** 78°52'32"W**Geologic unit:** Clarion Formation, Allegheny Group**Description:** Medium-gray noncalcareous underclay to the Lower Kittanning coal that locally reaches thicknesses of 10 to 12 feet (3 to 4 m). Only the upper part of the underclay is exposed in the strip pit. The upper 2 feet (0.6 m) of the underclay is reportedly sold to manufacturer for use in fire brick and block. Fragments of underclay are commonly hackly.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Grab sample from stockpile**Chemical analysis: Mineralogy (X-ray): Raw properties:**

	%		%	
SiO ₂	52.90	Quartz	22	Water of plasticity (%): 19.1
TiO ₂	1.79	Mica	44	Drying shrinkage (%): 5.0
Al ₂ O ₃	26.15	Kaolinite	32	Workability: Plastic
Fe ₂ O ₃	1.96	Chlorite-		Dry strength: Good
MnO	0.014	vermiculite	0	Drying defects: None
MgO	0.87	Feldspar	2	pH: 5.2
CaO	0.05	Montmo-		
Na ₂ O	0.25	rillonite	0	
K ₂ O	3.04	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Yellowish white	3	5.0	16.0	29.3	1.82
982	(10YR9/2)					
1900	Yellowish white	3	5.0	14.5	27.4	1.89
1038	(10YR9/2)					
2000	Yellowish white	3	7.5	13.4	25.8	1.92
1093	(10YR9/2)					
2100	Yellowish white to	4	7.5	10.1	20.6	2.04
1149	pale yellow (2.5Y9/2)					
2200	Pale to grayish	7	10.0	3.3	7.5	2.25
1204	yellow (2.5Y8/4)					
2300	Yellowish gray to	7	12.5	1.6	3.7	2.26
1260	grayish yellow (2.5Y8/2)					

Pyrometric cone equivalent: ND**Bloating test:** Negative

*Munsell designation

Remarks: Good color range. No effervescence when treated with hydrochloric acid.

Potential uses: Grade SW building brick; structural tile (facing); stoneware.

CAMBRIA COUNTY Jackson Twp. Vintondale quad.

Sample number **67-A-5A**

Location: Stripping operation by the Ace Drilling Coal Company, Inc., located north of the village of Chickaree.

Latitude: 40°27'10"N

Longitude: 78°53'02"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium-dark-gray underclay to the Middle Kittanning coal is exposed for a total thickness of 16 inches (41 cm). Sandstone occurs underneath the underclay.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample through 16 inches (41 cm)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	59.70	Quartz	26	Water of plasticity (%): 17.7
TiO ₂	1.09	Mica	57	Drying shrinkage (%): 7.5
Al ₂ O ₃	20.90	Kaolinite	16	Workability: Plastic
Fe ₂ O ₃	4.18	Chlorite-		Dry strength: Good
MnO	0.022	vermiculite	0	Drying defects: None
MgO	0.77	Feldspar	1	pH: 5.1
CaO	0.12	Montmo-		
Na ₂ O	0.19	rillonite	0	
K ₂ O	3.40	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Yellowish white	2	7.5	14.8	27.8	1.88
982	(10YR9/2)					
1900	Yellowish white	3	7.5	14.2	27.0	1.91
1038	(10YR9/2)					
2000	Pale orange yellow	3	7.5	12.7	24.9	1.94
1093	(7.5YR8/4)					
2100	Light yellowish	4	7.5	9.7	20.1	1.97
1149	brown (7.5YR7/4)					

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2200	Light yellowish	5	7.5	5.7	11.1	2.09
1204	brown (10YR7/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Abrupt vitrification (2200-2300°F). No effervescence when treated with HCl.**Potential uses:** Grade SW building brick; structural tile (load-bearing).

*Munsell designation

CAMBRIA COUNTY Jackson Twp. Vintondale quad.Sample number **67-A-5B****Location:** Stripping operation by the Ace Drilling Coal Company, Inc., located north of the village of Chickaree.**Latitude:** 40°27'10"N**Longitude:** 78°53'02"W**Geologic unit:** Kittanning Formation, Allegheny Group**Description:** Dark-gray noncalcareous claystone occurs above the Middle Kittanning coal for an interval of 25 to 30 feet (8 to 9 m). Thickness of beds ranges from about 2 inches (5 cm) up to 6 inches (15 cm). Fragments are commonly hackly.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Channel from 0 to 10 feet (0 to 3 m) above coal**Chemical analysis:** **Mineralogy (X-ray):** **Raw properties:**

	%		%	
SiO ₂	56.30	Quartz	20	Water of plasticity (%): 17.0
TiO ₂	1.04	Mica	52	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.90	Kaolinite	25	Workability: Short
Fe ₂ O ₃	8.80	Chlorite-		Dry strength: Fair
MnO	0.141	vermiculite	0	Drying defects: None
MgO	1.78	Feldspar	1	pH: 7.0
CaO	0.35	Montmo-		
Na ₂ O	0.22	rillonite	2	
K ₂ O	3.39	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate yellow	2	5.0	17.0	31.1	1.83
982	pink (5YR7/6)					
1900	Grayish reddish	2	7.5	15.3	28.8	1.88
1038	orange (2.5YR6/6)					
2000	Grayish reddish	3	7.5	13.9	26.8	1.93
1093	orange (2.5YR6/6)					
2100	Grayish reddish	4	7.5	9.0	19.0	2.12
1149	orange (2.5YR5/6)					
2200	Grayish reddish	7	10.0	2.6	5.8	2.27
1204	brown (2.5YR4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Positive

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Platy

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	2.30	143.5	7.1	No expansion.
982				
1900	2.18	136.0	7.0	No expansion.
1038				
2000	2.04	127.3	7.5	No expansion.
1093				
2100	1.69	105.5	10.4	Slight expansion.
1149				
2200	1.13	70.5	13.5	Good pore structure.
1204				
2300	0.84	52.4	11.4	Overfired; sticky.
1260				

Remarks: Marginal raw material for lightweight aggregate. Heavy.

Potential uses: Grade SW building brick. Marginal raw material for lightweight aggregate (heavy).

CAMBRIA COUNTY West Taylor Twp. Vintondale quad.Sample number **67-A-8****Location:** Exposure along the east side of Pa. Route 403, about 3 miles (4.8 km) south-southeast of the village of Cramer.**Latitude:** 40°23'00"N**Longitude:** 78°57'54"W**Geologic unit:** Catskill Formation, Devonian age**Description:** Predominantly grayish-red and some greenish-gray shales of the Catskill Formation occur directly below sandstones of the Devonian Oswayo Formation. Some of the shale is calcareous. Fragments of shale are commonly hackly and relatively small.**Attitude of bedding:** Essentially horizontal; dip measures about 4 degrees to the northeast**Weathering intensity:** Slight**Sampled interval:** Channel from 0 to 10 feet (0 to 3 m) below Oswayo-Catskill contact**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	60.40	Quartz	21	Water of plasticity (%): 15.4
TiO ₂	0.85	Mica	74	Drying shrinkage (%): 5.0
Al ₂ O ₃	17.20	Kaolinite	0	Workability: Plastic
Fe ₂ O ₃	7.20	Chlorite-		Dry strength: Good
MnO	0.101	vermiculite	2	Drying defects: None
MgO	1.61	Feldspar	3	pH: 7.8
CaO	0.85	Montmo-		
Na ₂ O	0.47	rillonite	0	
K ₂ O	4.48	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Moderate orange	3	5.0	11.6	23.1	1.98
982	(2.5YR6/8)					
1900	Brownish orange	3	5.0	8.7	18.5	2.11
1038	(2.5YR5/8)					
2000	Brownish orange	3	7.5	7.8	16.9	2.15
1093	(2.5YR5/8)					
2100	Grayish reddish	7	7.5	3.3	7.5	2.31
1149	orange (2.5YR5/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative

*Munsell designation

Remarks: Abrupt vitrification (2100-2200°F). Too soft. Slight effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

CAMBRIA COUNTY West Taylor Twp. Vintondale quad.

Sample number **67-A-9A**

Location: Exposure on the east side of a medium-duty road, about 1600 feet (490 m) northwest of the northwest corner of Laurel Run Reservoir.

Latitude: 40°23'16"N

Longitude: 78°55'13"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Predominantly olive-gray and some medium-gray claystones, grading down into silty shales, are exposed for an interval of 9 feet (2.7 m) below a coal seam (Upper Freeport?). Fragments of the material are usually hackly. Colors change to brown and tan upon weathering; iron staining is common along joints.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel through 9 stratigraphic feet (2.7 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	61.70	Quartz	27	Water of plasticity (%): 19.6
TiO ₂	1.03	Mica	48	Drying shrinkage (%): 5.0
Al ₂ O ₃	18.10	Kaolinite	23	Workability: Plastic
Fe ₂ O ₃	6.26	Chlorite-		Dry strength: Fair
MnO	0.092	vermiculite	1	Drying defects: None
MgO	1.28	Feldspar	1	pH: 6.8
CaO	0.23	Montmo-		
Na ₂ O	0.23	rillonite	0	
K ₂ O	3.06	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate yellowish	2	5.0	19.0	32.9	1.73
982	pink (5YR7/6)					
1900	Moderate orange	2	5.0	17.6	31.4	1.78
1038	(5YR7/6)					
2000	Moderate orange	3	7.5	15.1	28.1	1.87
1093	(5YR7/6)					
2100	Moderate orange	4	7.5	10.6	21.5	2.03
1149	(5YR7/8)					

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2200	Grayish reddish	7	12.5	2.9	6.5	2.27
1204	brown (2.5YR4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

CAMBRIA COUNTY West Taylor Twp. Vintondale quad.

Sample number **67-A-9B**

Location: Exposure on the east side of a medium-duty road, about 1600 feet (490 m) northwest of the northwest corner of Laurel Run Reservoir.

Latitude: 40°23'16"N

Longitude: 78°55'13"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Medium-dark-gray to olive-gray, thin-bedded silty shales and shaly siltstones occur stratigraphically below sample of 67-A-9A. Rock material breaks relatively easily into platy fragments. Brownish iron stains in minor amounts were observed along fractures. Thickness of beds ranges from < 1/2 inch (< 1.3 cm) up to about 2-1/2 inches (6.4 cm). Bottom of sampled interval is in contact with a coal blossom.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel through 9 stratigraphic feet (2.7 m)

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	65.70	Quartz	34	Water of plasticity (%): 19.4
TiO ₂	0.92	Mica	50	Drying shrinkage (%): 5.0
Al ₂ O ₃	16.65	Kaolinite	11	Workability: Plastic
Fe ₂ O ₃	5.20	Chlorite-		Dry strength: Good
MnO	0.062	vermiculite	4	Drying defects: None
MgO	1.22	Feldspar	1	pH: 6.7
CaO	0.15	Montmo-		
Na ₂ O	0.22	rillonite	0	
K ₂ O	2.78	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Moderate orange	2	5.0	19.2	33.3	1.73
982	(5YR7/6)					
1900	Moderate orange	2	5.0	18.1	32.0	1.77
1038	(5YR7/6)					
2000	Moderate orange	2	5.0	20.1	35.9	1.78
1093	(5YR7/6)					
2100	Light brown to mod.	3	5.0	12.4	24.1	1.95
1149	orange (5YR6/6)					
2200	Moderate reddish	7	10.0	4.7	10.3	2.18
1204	brown (2.5YR4/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Too soft. Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.**Potential uses:** Not suitable for use in vitreous clay products.

*Munsell designation

CAMBRIA COUNTY Lower Yoder Twp. Johnstown quad.Sample number **67-C-1****Location:** Strip pit operated by Pennsylvania Energy, located about 3 miles (4.8 km) west-northwest of Johnstown.**Latitude:** 40°19'55"N**Longitude:** 78°58'54"W**Geologic unit:** Glenshaw Formation, Conemaugh Group

Description: Olive-gray to olive-black claystone, grading stratigraphically upward into silty claystone, occurs for an interval of 10 feet (3 m) above the Upper Freeport coal. Beds of silty claystone are distinguishable and range in thickness from 1-1/2 to 1-3/4 inches (3.8 to 4.4 cm). The claystones break down into slabby or rubbly fragments and iron staining is common along weathered surfaces and joints. A sandstone bed identifies the upper limit of the sampled interval.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Channel sample through 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	58.60	Quartz	28	Water of plasticity (%): 18.2	
TiO ₂	0.96	Mica	54	Drying shrinkage (%): 5.0	
Al ₂ O ₃	19.30	Kaolinite	15	Workability: Plastic	
Fe ₂ O ₃	6.29	Chlorite-		Dry strength: Good	
MnO	0.088	vermiculite	2	Drying defects: None	
MgO	1.51	Feldspar	1	pH: 6.9	
CaO	0.25	Montmo-			
Na ₂ O	0.22	rillonite	0		
K ₂ O	3.37	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light to mod. yellow-	2	5.0	17.7	31.4	1.78
982	ish pink (5YR8/4)					
1900	Moderate orange	3	5.0	15.4	28.5	1.85
1038	(5YR7/6)					
2000	Moderate orange	3	5.0	12.2	24.0	1.97
1093	(5YR7/6)					
2100	Moderate orange	6	5.0	6.9	15.0	2.17
1149	(5YR7/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

CAMBRIA COUNTY Lower Yoder Twp. Johnstown quad.

Sample number **67-C-2**

Location: Strip pit operated by Pennsylvania Energy, located about 3 miles (4.8 km) west-northwest of Johnstown.

Latitude: 40°19'57"N

Longitude: 78°58'25"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Underclay to the Upper Freeport coal is exposed in parts of the stripping. Predominant colors of the underclay are pale to dark yellow brown. Test with dilute hydrochloric acid was negative (no effervescence).

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 41 inches (104 cm) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	60.80	Quartz	26	Water of plasticity (%): 24.1
TiO ₂	1.09	Mica	57	Drying shrinkage (%): 5.0
Al ₂ O ₃	22.80	Kaolinite	21	Workability: Plastic
Fe ₂ O ₃	3.53	Chlorite-		Dry strength: Good
MnO	0.014	vermiculite	1	Drying defects: None
MgO	1.08	Feldspar	1	pH: 7.0
CaO	0.41	Montmo-		
Na ₂ O	0.19	rillonite	0	
K ₂ O	3.92	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light to mod. orange	2	5.0	17.4	30.5	1.75
982	yellow (7.5YR8/6)					
1900	Light to mod. orange	3	7.5	13.8	25.8	1.87
1038	yellow (7.5YR8/6)					
2000	Light to mod. orange	4	7.5	10.8	21.5	1.99
1093	yellow (7.5YR8/6)					
2100	Moderate orange	7	10.0	4.1	9.1	2.24
1149	(5YR7/6)					
2200	Light yellowish	7	15.0	1.0	2.3	2.31
1204	brown (10YR6/4)					
2300	--	—	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2200-2300°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick; structural tile (facing).

*Munsell designation

CAMBRIA COUNTY Conemaugh Twp. Johnstown quad.

Sample number **67-C-7**

Location: Exposure along the north side of Pa. Route 56, about 4000 feet (1220 m) east of the village of Dale.

Latitude: 40°19'00"N

Longitude: 78°53'26"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium-dark-gray interbedded fissile shales and silty shales occur below a 3-foot- (0.9-m-) thick carbonate layer, the latter probably the Johnstown limestone horizon under the Upper Kittanning coal. Siderite in the form of thin bands and nodules occurs locally throughout the interval. Rock breaks into papery to chippy fragments having angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel from 3 to 15 feet (0.9 to 4.6 m) beneath the carbonate layer

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	60.50	Quartz	16	Water of plasticity (%): 16.7	
TiO ₂	1.03	Mica	62	Drying shrinkage (%): 5.0	
Al ₂ O ₃	20.20	Kaolinite	15	Workability: Short	
Fe ₂ O ₃	5.28	Chlorite-		Dry strength: Fair	
MnO	0.054	vermiculite	5	Drying defects: None	
MgO	1.67	Feldspar	2	pH: 7.4	
CaO	0.25	Montmo-			
Na ₂ O	0.22	rillonite	0		
K ₂ O	3.67	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Pale orange yellow	3	5.0	14.8	27.9	1.88
982	(7.5YR8/4)					
1900	Light to mod. yel-	3	5.0	13.5	26.1	1.94
1038	lowish pink (5YR8/4)					
2000	Light to mod. yel-	3	5.0	12.1	23.9	1.98
1093	lowish pink (5YR8/4)					
2100	Moderate orange	7	7.5	8.5	18.0	2.11
1149	(5YR7/6)					
2200	Grayish brown	7	10.0	3.2	7.3	2.25
1204	(7.5YR4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2200-2300°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

CAMBRIA COUNTY Croyle Twp. Geistown quad.Sample number **67-D-3A****Location:** Exposure along the east side of U.S. Route 219, about 6000 feet (1830 m) east-southeast of the village of South Fork.**Latitude:** 40°21'45"N**Longitude:** 78°46'10"W**Geologic unit:** Casselman Formation, Conemaugh Group**Description:** Brownish-black to black, noncalcareous, fissile shale occurs between two coal seams which measure 38 inches (97 cm) and 5-1/2 inches (14 cm). The interval of shale measures 9 stratigraphic feet (2.7 m). Yellow to red iron staining is common along bedding and joint planes in the shale. Coal seams probably represent the Wellersburg coal horizon.**Attitude of bedding:** Essentially horizontal; beds dip from 1 to 2 degrees to the east-southeast**Weathering intensity:** Moderate**Sampled interval:** Channel sample through 9 stratigraphic feet (2.7 m) of shale**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	56.20	Quartz	22	Water of plasticity (%): 21.7
TiO ₂	0.98	Mica	54	Drying shrinkage (%): 5.0
Al ₂ O ₃	17.25	Kaolinite	16	Workability: Plastic
Fe ₂ O ₃	7.50	Chlorite-		Dry strength: Good
MnO	0.044	vermiculite	2	Drying defects: None
MgO	1.45	Feldspar	3	pH: 4.8
CaO	0.14	Montmo-		
Na ₂ O	0.52	rillonite	3	
K ₂ O	2.97	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	7.5	25.0	39.2	1.57
982	(5YR7/8)					
1900	Moderate orange	2	7.5	21.7	35.9	1.65
1038	(2.5YR6/8)					
2000	Brownish orange	3	7.5	16.6	29.7	1.79
1093	(2.5YR5/8)					
2100	Strong brown	4	10.0	10.5	20.8	2.00
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative

* Munsell designation

Remarks: Too soft. Abrupt vitrification (2100-2200°F).

Potential uses: Not suitable for use in vitreous clay products.

CAMBRIA COUNTY Croyle Twp. Geistown quad.

Sample number **67-D-3B**

Location: Exposure along the east side of U.S. Route 219, about 6000 feet (1830 m) east-southeast of the village of South Fork.

Latitude: 40°21'45"N

Longitude: 78°46'10"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Medium-light-gray to medium-gray claystone occurs from 0 to 10 feet (0 to 3 m) beneath a 5-1/2-inch (14-cm) coal seam. Fragments of the claystone are hackly and are commonly from 1/2 inch (1.3 cm) to several inches in their long dimension. Iron staining, ranging from light brown to grayish brown, is present in the claystone. Coal seam probably represents part of the Wellersburg coal horizon.

Attitude of bedding: Essentially horizontal; beds dip from 1 to 2 degrees to the east-southeast

Weathering intensity: Moderate

Sampled interval: Channel sample through 10 stratigraphic feet (3 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

%		%		
SiO ₂	60.80	Quartz	22	Water of plasticity (%): 21.6
TiO ₂	1.00	Mica	65	Drying shrinkage (%): 5.0
Al ₂ O ₃	18.15	Kaolinite	9	Workability: Plastic
Fe ₂ O ₃	8.02	Chlorite-		Dry strength: Good
MnO	0.153	vermiculite	3	Drying defects: None
MgO	1.71	Feldspar	1	pH: 5.1
CaO	0.30	Montmo-		
Na ₂ O	0.38	rillonite	0	
K ₂ O	3.55	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	17.4	30.9	1.78
982	(5YR7/6)					
1900	Light brown to mod.	3	7.5	13.7	26.0	1.90
1038	orange (5YR6/6)					
2000	Light brown to mod.	3	10.0	9.4	19.4	2.06
1093	orange (5YR6/6)					

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color*</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2100	Moderate reddish	7	12.5	3.1	7.1	2.27
1149	brown (2.5YR4/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Positive**Remarks:** Claystone did not effervesce when dilute HCl was applied.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Angular Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	2.08	129.8	10.7	No expansion.
982				
1900	2.05	127.9	8.3	No expansion.
1038				
2000	1.94	121.1	10.0	No expansion.
1093				
2100	1.79	111.7	7.5	No expansion.
1149				
2200	1.43	89.2	9.0	Good pore structure.
1204				
2300	1.01	63.0	6.8	Overfired; sticky.
1260				

Remarks: Not suitable for use as lightweight aggregate. Heavy.**Potential uses:** Not suitable for use in vitreous clay products or for use as lightweight aggregate.**CAMBRIA COUNTY Conemaugh Twp. Geistown quad.**

Sample number 67-D-6

Location: Exposure on the north side of Pa. Route 56, about 2 miles (3 km) west of the western fringe of the Johnstown-Cambria County Airport.

Latitude: 40°18'52"N

Longitude: 78°52'29"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Olive-black noncalcareous shale occurs for an interval of 6 feet (1.8 m) below an 8-inch (20-cm) coal. Small nodules or thin layers of siderite are present locally throughout the sampled interval. Shale grades downward into silty shale. Rock breaks into platy fragments having angular edges. Upper part of sample is iron stained and weathers to a yellow-brown color. Sampled interval probably lies between the Upper and Middle Kittanning coals.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 6 stratigraphic feet (1.8 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	60.80	Quartz	29	Water of plasticity (%): 17.1
TiO ₂	0.96	Mica	56	Drying shrinkage (%): 7.5
Al ₂ O ₃	17.55	Kaolinite	7	Workability: Short
Fe ₂ O ₃	7.35	Chlorite-		Dry strength: Fair
MnO	0.114	vermiculite	7	Drying defects: None
MgO	1.46	Feldspar	1	pH: 6.1
CaO	0.25	Montmo-		
Na ₂ O	0.20	rillonite	0	
K ₂ O	3.22	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Mod. yellow pink to	2	5.0	17.1	30.7	1.80
982	mod. orange (5YR7/6)					
1900	Moderate orange	2	5.0	14.9	28.1	1.89
1038	(5YR7/6)					
2000	Moderate orange	3	7.5	9.6	20.0	2.06
1093	(5YR7/6)					
2100	Moderate orange	4	7.5	6.0	13.4	2.25
1149	(5YR6/6)					
2200	Grayish reddish	7	12.5	3.0	6.8	2.23
1204	brown (2.5YR4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Abrupt vitrification (2200-2300°F). No effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: --

Particle size: Pelletized

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	1.83	114.2	15.5	No expansion.
982				
1900	1.77	110.5	16.3	No expansion.
1038				
2000	1.78	111.1	14.6	No expansion.
1093				
2100	1.72	107.3	12.9	Slight expansion.
1149				
2200	1.31	81.7	11.0	Good pore structure.
1204				
2300	1.10	68.6	8.4	Overfired; sticky.
1260				

Remarks: Not suitable for use as lightweight aggregate. Heavy.**Potential uses:** Grade SW building brick.**CAMBRIA COUNTY Chest Twp. Hastings quad.**Sample number **76-A-2A****Location:** Strip pit operated by Lechene Coal Company, Inc., located about 6800 feet (2070 m) southwest of the village of St. Lawrence.**Latitude:** 40°41'24"N**Longitude:** 78°38'51"W**Geologic unit:** Kittanning Formation, Allegheny Group**Description:** Medium-dark-gray to dark-gray underclay to the Upper Kittanning coal is exposed in the stripping. This sample represents the interval from 0 to 31 inches (0 to 79 cm) below the coal. Sandstone occurs above the coal throughout the exposure.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** From 0 to 31 inches (0 to 79 cm) below the Upper Kittanning coal; channel sample

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	64.70	Quartz	33	Water of plasticity (%): 22.3
TiO ₂	1.12	Mica	39	Drying shrinkage (%): 5.0
Al ₂ O ₃	20.05	Kaolinite	25	Workability: Plastic
Fe ₂ O ₃	1.78	Chlorite-		Dry strength: Good
MnO	0.014	vermiculite	0	Drying defects: None
MgO	0.73	Feldspar	3	pH: 5.9
CaO	0.21	Montmo-		
Na ₂ O	0.16	rillonite	0	
K ₂ O	2.60	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Yellowish white	3	5.0	18.1	31.1	1.72
982	(10YR9/2)					
1900	Yellowish white	3	7.5	16.3	29.0	1.78
1038	(10YR9/2)					
2000	Yellowish white	3	7.5	12.8	24.3	1.89
1093	(10YR9/2)					
2100	Yellowish white	4	10.0	8.6	17.5	2.03
1149	(2.5Y9/2)					
2200	Pale to grayish	7	12.5	0.6	1.3	2.29
1204	yellow (2.5Y8/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick; structural tile (facing).

*Munsell designation

CAMBRIA COUNTY Chest Twp. Hastings quad.

Sample number 76-A-2B

Location: Strip pit operated by Lechene Coal Company, Inc., located about 6800 feet (2070 m) southwest of the village of St. Lawrence.

Latitude: 40°41'24"N

Longitude: 78°38'51"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Dark-gray to black portion of the underclay to the Upper Kittanning coal that occurs from 31 to 48 inches (79 to 122 cm) below the coal. This sample was collected separately from sample 76-A-2A because of the color change in material.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: From 31 to 48 inches (79 to 122 cm) below the Upper Kittanning coal; channel sample

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	57.20	Quartz	22	Water of plasticity (%): 26.2	
TiO ₂	0.90	Mica	53	Drying shrinkage (%): 5.0	
Al ₂ O ₃	16.65	Kaolinite	5	Workability: Plastic	
Fe ₂ O ₃	12.85	Chlorite-		Dry strength: Good	
MnO	0.148	vermiculite	3	Drying defects: None	
MgO	1.06	Feldspar	2	pH: 6.2	
CaO	0.45	Montmo-			
Na ₂ O	0.14	rillonite	10		
K ₂ O	2.60	Calcite	0		
		Goethite	5		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	7.5	22.0	36.7	1.67
982	(5YR7/6)					
1900	Moderate orange	3	7.5	18.1	32.4	1.79
1038	(5YR7/6)					
2000	Light brown	3	10.0	13.1	25.5	1.95
1093	(5YR6/6)					
2100	Strong brown	7	12.5	7.7	16.5	2.14
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F). Too soft. No effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

CAMBRIA COUNTY Elder Twp. Hastings quad.Sample number **76-A-4**

Location: Exposure on the north side of an unimproved road trending northwest from the village of Plattsville to connect with Pa. Route 36. The exposure occurs about 2500 feet (760 m) west of the Route 36 intersection.

Latitude: 40°42'16"N

Longitude: 78°42'14"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Light-olive-gray noncalcareous silty claystone is exposed along the road. Some reddish-brown iron staining is present along fractures. Claystone breaks into hackly fragments having angular edges. Sampled interval was taken from the upper part of the exposure downward through 12 stratigraphic feet (4 m).

Attitude of bedding: N65E, 18N**Weathering intensity:** Slight**Sampled interval:** Channel through 12 stratigraphic feet (4 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	65.00	Quartz	32	Water of plasticity (%): 20.6	
TiO ₂	0.98	Mica	53	Drying shrinkage (%): 5.0	
Al ₂ O ₃	17.75	Kaolinite	7	Workability: Plastic	
Fe ₂ O ₃	5.46	Chlorite-		Dry strength: Good	
MnO	0.046	vermiculite	3	Drying defects: None	
MgO	1.02	Feldspar	3	pH: 5.7	
CaO	0.07	Montmo-			
Na ₂ O	0.20	rillonite	2		
K ₂ O	3.29	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	17.2	30.6	1.78
982	(5YR7/6)					
1900	Moderate orange	2	7.5	15.5	28.6	1.84
1038	(5YR7/6)					
2000	Moderate orange	3	7.5	12.6	24.5	1.95
1093	(5YR7/8)					
2100	Moderate orange	4	7.5	8.9	18.4	2.08
1149	(5YR6/8)					

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color*</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2200	Moderate reddish	7	12.5	2.9	6.6	2.27
1204	brown (2.5YR4/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

CAMBRIA COUNTY White Twp. Coalport quad.

Sample number **76-B-7**

Location: Exposure along the southeast side of the medium-duty road leading generally south from the village of Fiske, located about 2.5 miles (4 km) by road from Fiske.

Latitude: 40°38'37"N

Longitude: 78°31'12"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-gray to greenish-gray claystone is exposed in a small pit alongside the road. Beds appear to be up to 3 inches (7.6 cm) thick and the claystone is relatively soft. Fragments of the claystone are commonly chippy to platy and have angular edges. When broken the inside colors of the fragments are light olive gray, greenish gray, and olive black.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel sample through 12 stratigraphic feet (4 m)

Chemical analysis: **Mineralogy (X-ray):** **Raw properties:**

	%		%	
SiO ₂	59.50	Quartz	21	Water of plasticity (%): 23.4
TiO ₂	0.94	Mica	54	Drying shrinkage (%): 5.0
Al ₂ O ₃	20.80	Kaolinite	13	Workability: Plastic
Fe ₂ O ₃	7.05	Chlorite-		Dry strength: Good
MnO	0.065	vermiculite	2	Drying defects: None
MgO	1.90	Feldspar	6	pH: 6.5
CaO	0.24	Montmo-		
Na ₂ O	0.59	rillonite	4	
K ₂ O	3.40	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Moderate yellowish	2	5.0	19.7	33.7	1.72
982	pink (5YR7/6)					
1900	Moderate orange	3	7.5	15.4	28.4	1.85
1038	(5YR7/8)					
2000	Moderate orange	4	10.0	11.3	22.4	1.98
1093	(5YR6/8)					
2100	Brownish orange	6	10.0	4.7	10.4	2.24
1149	(2.5YR5/8)					
2200	Grayish reddish	7	15.0	1.1	2.6	2.27
1204	brown (2.5YR4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Abrupt vitrification (2200-2300°F). No effervescence with HCl.**Potential uses:** Grade SW building brick.

*Munsell designation

CAMBRIA COUNTY East Carroll Twp. Carrolltown quad.Sample number **76-C-3****Location:** Exposure on the east side of U.S. Route 219, about 4 road miles (6.4 km) south of the center of Carrolltown.**Latitude:** 40°32'57"N**Longitude:** 78°43'05"W**Geologic unit:** Glenshaw Formation, Conemaugh Group**Description:** Light- to moderate-olive-brown, noncalcareous, thin-bedded silty shales occur in the exposure. Beds are commonly under 1 inch (2.5 cm) in thickness. Shale fragments are usually platy and have angular edges.**Attitude of bedding:** N5W, 11E**Weathering intensity:** Slight to moderate**Sampled interval:** Channel through lower 10 stratigraphic feet (3 m) of the exposure

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	57.90	Quartz	23	Water of plasticity (%): 19.6
TiO ₂	1.05	Mica	55	Drying shrinkage (%): 7.5
Al ₂ O ₃	18.65	Kaolinite	11	Workability: Plastic
Fe ₂ O ₃	8.27	Chlorite-		Dry strength: Good
MnO	0.077	vermiculite	3	Drying defects: None
MgO	1.86	Feldspar	5	pH: 6.8
CaO	0.31	Montmo-		
Na ₂ O	0.23	rillonite	3	
K ₂ O	3.63	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	7.5	17.7	31.7	1.80
982	(5YR7/8)					
1900	Moderate orange	2	10.0	15.8	29.3	1.86
1038	(5YR7/8)					
2000	Brownish orange	3	10.0	11.8	23.6	1.99
1093	(2.5YR5/8)					
2100	Brownish orange	6	10.0	8.7	18.2	2.10
1149	(2.5YR5/8)					
2200	Moderate reddish	7	12.5	3.0	6.9	2.27
1204	brown (2.5YR4/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

CAMBRIA COUNTY East Carroll Twp. Carrolltown quad.

Sample number 76-C-4

Location: Exposure along the east side of U.S. Route 219, about 3.55 road miles (5.7 km) south of the center of Carrolltown.

Latitude: 40°33'19"N

Longitude: 78°43'00"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Interbedded greenish-gray shales and silty shales are exposed in a quarry. Shales break into platy fragments, whereas the silty shales form chippy or slabby fragments. Weathered fragments commonly are light olive brown in their interior.

Attitude of bedding: Essentially horizontal. Zero-degree dip measured on bedding plane.

Weathering intensity: Slight

Sampled interval: Channel sample through 11 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	58.80	Quartz	26	Water of plasticity (%): 21.3
TiO ₂	0.97	Mica	60	Drying shrinkage (%): 5.0
Al ₂ O ₃	18.65	Kaolinite	1	Workability: Plastic
Fe ₂ O ₃	8.22	Chlorite-		Dry strength: Good
MnO	0.074	vermiculite	4	Drying defects: None
MgO	1.84	Feldspar	3	pH: 6.9
CaO	0.45	Montmo-		
Na ₂ O	0.32	rillonite	6	
K ₂ O	3.31	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color*</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Moderate orange	2	5.0	18.1	32.3	1.78
982	(5YR7/8)					
1900	Moderate orange	2	7.5	15.4	28.9	1.88
1038	(5YR6/8)					
2000	Brownish orange	3	10.0	10.7	21.9	2.04
1093	(5YR5/8)					
2100	Brownish orange	6	10.0	7.1	15.6	2.18
1149	(2.5YR5/8)					
2200	Moderate reddish	7	15.0	1.1	2.6	2.34
1204	brown (2.5YR3/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

CAMBRIA COUNTY Allegheny Twp. Carrolltown quad.

Sample number **76-C-5**

Location: Exposure along the Penn Central Railroad, about 6800 feet (2070 m) from the village of Driscoll as measured generally south along the tracks.

Latitude: 40°31'03"N

Longitude: 78°39'24"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Olive-gray silty shales grading down to shales are exposed in the upper part of the railroad cut. Beds are usually less than 1/2 inch (1.3 cm) thick. Fragments from sampled interval are generally platy to chippy and have angular edges. Type of material sampled extends down to a depth of about 25 feet (8 m) below the surface. Sampled interval is noncalcareous.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 12 stratigraphic feet (3.7 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	62.90	Quartz	34	Water of plasticity (%): 17.6
TiO ₂	0.95	Mica	54	Drying shrinkage (%): 5.0
Al ₂ O ₃	16.80	Kaolinite	0	Workability: Short
Fe ₂ O ₃	6.68	Chlorite-		Dry strength: Poor
MnO	0.093	vermiculite	4	Drying defects: None
MgO	1.57	Feldspar	8	pH: 6.0
CaO	0.23	Montmo-		
Na ₂ O	0.98	rillonite	0	
K ₂ O	2.62	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	18.3	32.2	1.76
982	(5YR7/6)					
1900	Moderate orange	2	5.0	16.5	30.1	1.83
1038	(5YR6/8)					
2000	Moderate orange	3	5.0	12.3	23.9	1.94
1093	(5YR6/8)					
2100	Grayish reddish	4	7.5	8.6	17.6	2.05
1149	orange (2.5YR5/6)					
2200	Moderate reddish	7	12.5	2.6	5.9	2.23
1204	brown (2.5YR3/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

* Munsell designation

CAMBRIA COUNTY Gallitzin Twp. Ashville quad.Sample number **76-D-1****Location:** Exposure on the north side of Pa. Route 36, about 2.4 road miles (3.9 km) east of the village of Ashville.**Latitude:** 40°32'51"N**Longitude:** 78°30'17"W**Geologic unit:** Glenshaw Formation, Conemaugh Group**Description:** Medium-dark-gray noncalcareous thin-bedded shales and silty shales occur in the road exposure. Beds are commonly less than 1 inch (2.5 cm) in thickness. Fragments of rock material are either chippy or platy and have angular edges. Some brownish iron staining is present locally along fractures and bedding.**Attitude of bedding:** N-S, 7E**Weathering intensity:** Slight to moderate**Sampled interval:** Representative sample of 12 stratigraphic feet (4 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	60.90	Quartz	33	Water of plasticity (%): 17.5
TiO ₂	1.00	Mica	43	Drying shrinkage (%): 5.0
Al ₂ O ₃	16.85	Kaolinite	13	Workability: Short
Fe ₂ O ₃	6.75	Chlorite-		Dry strength: Poor
MnO	0.096	vermiculite	8	Drying defects: None
MgO	1.50	Feldspar	3	pH: 6.5
CaO	0.16	Montmo-		
Na ₂ O	0.22	rillonite	0	
K ₂ O	2.75	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Moderate orange	2	5.0	17.6	31.3	1.77
982	(5YR7/6)					
1900	Moderate orange	2	5.0	16.0	29.2	1.83
1038	(5YR7/6)					
2000	Moderate orange	3	7.5	13.6	25.9	1.91
1093	(5YR7/8)					
2100	Grayish reddish	4	7.5	10.6	21.3	2.01
1149	orange (2.5YR5/6)					
2200	Moderate reddish	7	10.0	3.4	7.7	2.23
1204	brown (2.5YR3/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative

*Munsell designation

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

CAMBRIA COUNTY Clearfield Twp. Ashville quad.

Sample number **76-D-6**

Location: Exposure along the northwest side of a medium-duty road leading southeast from the village of St. Augustine, and about 5600 feet (1710 m) by road from that village.

Latitude: 40°36'08"N

Longitude: 78°34'12"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Olive-gray claystone in the lower 6 feet (1.8 m) of the exposure grades upward into shale and silty shale. Bedding is poorly developed in the claystone, but is distinctly fissile to thin in the shale and silty shale. Fragments are commonly papery, platy, or flaggy and have angular edges. All material is noncalcareous.

Attitude of bedding: N85W, 7N

Weathering intensity: Moderate

Sampled interval: Ten stratigraphic feet (3 m), starting from base of claystone and sampling upward

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	57.90	Quartz	23	Water of plasticity (%): 20.0
TiO ₂	0.98	Mica	60	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.00	Kaolinite	2	Workability: Plastic
Fe ₂ O ₃	8.00	Chlorite-		Dry strength: Fair
MnO	0.196	vermiculite	5	Drying defects: None
MgO	1.86	Feldspar	6	pH: 6.7
CaO	0.40	Montmo-		
Na ₂ O	0.88	rillonite	4	
K ₂ O	3.32	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	19.0	32.9	1.73
982	(5YR6/6)					
1900	Brownish orange	3	7.5	15.0	27.9	1.85
1038	(5YR5/6)					
2000	Brownish orange	3	10.0	10.8	21.6	2.00
1093	(5YR5/6)					

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
2100	Strong brown	6	10.0	5.2	11.5	2.19
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Positive

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: --

Particle size: Pelletized

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	1.72	107.3	19.2	No expansion.
982				
1900	1.70	106.1	17.9	No expansion.
1038				
2000	1.69	105.5	16.0	No expansion.
1093				
2100	1.52	94.9	14.6	Slight expansion.
1149				
2200	0.88	54.9	11.9	Good pore structure.
1204				
2300	0.64	39.9	15.3	Large pores.
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Lightweight aggregate.

CAMBRIA COUNTY Gallitzin Twp. Ashville quad.

Sample number 76-D-8

Location: Quarry exposure along the west side of Pa. Route 53, located about 4000 feet (1220 m) by road north of the village of Syberton.

Latitude: 40°31'02"N

Longitude: 78°34'44"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Olive-gray to medium-dark-gray claystones and silty claystones are exposed in the quarry. Beds are commonly 2 to 3 inches (5.1 to 7.6 cm) thick. A large amount of iron oxide staining, dark yellowish orange in color, is evident along fractures. Highwall of the quarry is about 25 feet (8 m) high. Rock materials are noncalcareous.

Attitude of bedding: N75E, 8N

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 10 stratigraphic feet (3 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	60.90	Quartz	31	Water of plasticity (%): 18.8
TiO ₂	1.06	Mica	49	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.00	Kaolinite	13	Workability: Plastic
Fe ₂ O ₃	6.18	Chlorite-		Dry strength: Fair
MnO	0.072	vermiculite	4	Drying defects: None
MgO	1.66	Feldspar	1	pH: 6.8
CaO	0.14	Montmo-		
Na ₂ O	0.23	rillonite	2	
K ₂ O	3.23	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	16.6	29.9	1.81
982	yellow (7.5YR8/6)					
1900	Moderate orange	3	7.5	14.3	27.0	1.89
1038	(5YR7/6)					
2000	Moderate orange	3	7.5	11.3	22.4	1.98
1093	(5YR6/8)					
2100	Brownish orange	4	10.0	8.2	17.1	2.09
1149	(5YR5/6)					
2200	Grayish brown	7	12.5	2.1	4.8	2.27
1204	(5YR4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

CAMBRIA COUNTY Munster Twp. Ebensburg quad.Sample number **77-A-1**

Location: Exposure along the west side of the light-duty road that parallels North Branch, about 4500 feet (1370 m) south-southwest of the intersection of U.S. Route 22 and the light-duty road.

Latitude: 40°27'11"N

Longitude: 78°41'10"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Olive-black noncalcareous fissile shale occurs stratigraphically below a sandstone. Shale breaks into platy fragments having angular edges. Some iron staining is present along bedding planes and joints.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate to severe

Sampled interval: Channel sample from 0 to 10 feet (0 to 3 m) above road level

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	57.90	Quartz	27	Water of plasticity (%): 19.3
TiO ₂	0.96	Mica	58	Drying shrinkage (%): 7.5
Al ₂ O ₃	19.20	Kaolinite	3	Workability: Plastic
Fe ₂ O ₃	7.35	Chlorite-		Dry strength: Good
MnO	0.094	vermiculite	6	Drying defects: None
MgO	2.02	Feldspar	6	pH: 6.6
CaO	0.26	Montmo-		
Na ₂ O	0.86	rillonite	0	
K ₂ O	3.35	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	7.5	18.7	32.7	1.75
982	(5YR7/6)					
1900	Moderate orange	2	7.5	16.5	29.9	1.81
1038	(5YR6/6)					
2000	Moderate orange	3	10.0	11.3	22.4	1.99
1093	(2.5YR6/8)					
2100	Grayish reddish	6	10.0	6.0	13.0	2.17
1149	orange (2.5YR5/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: --

Particle size: Pelletized

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	1.72	107.3	18.6	No expansion.
982				
1900	1.72	107.3	18.2	No expansion.
1038				
2000	1.72	107.3	16.9	No expansion.
1093				
2100	1.60	99.8	14.0	Slight expansion.
1149				
2200	1.03	64.3	11.3	Good pore structure.
1204				
2300	0.73	45.6	11.0	Some large pores; sticky.
1260				

Remarks: Marginal raw material for lightweight aggregate. Short firing range.**Potential uses:** Marginal lightweight aggregate.**CAMBRIA COUNTY Summerhill Twp. Ebensburg quad.**

Sample number 77-A-2

Location: Exposure on the north side of a medium-duty road about 1300 feet (400 m) west of its intersection with Pa. Route 160. The medium-duty road, trending generally east-west, lies north of the reservoir at Wilmore.**Latitude:** 40°23'26"N**Longitude:** 78°43'27"W**Geologic unit:** Casselman Formation, Conemaugh Group**Description:** Light-olive-gray, grayish-olive, and greenish-gray, interbedded shales and silty shales are exposed along the road. The silty shale breaks to form blocky fragments; the shale breaks into platy fragments. All are noncalcareous. Some iron staining is present.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Moderate to severe**Sampled interval:** Channel sample from 0 to 10 feet (0 to 3 m) above road level

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	62.50	Quartz	31	Water of plasticity (%): 18.5
TiO ₂	1.05	Mica	56	Drying shrinkage (%): 5.0
Al ₂ O ₃	17.25	Kaolinite	0	Workability: Short
Fe ₂ O ₃	6.42	Chlorite-		Dry strength: Fair
MnO	0.06	vermiculite	3	Drying defects: None
MgO	1.72	Feldspar	7	pH: 6.6
CaO	0.30	Montmo-		
Na ₂ O	0.90	rillonite	3	
K ₂ O	2.81	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	15.8	29.0	1.84
982	(5YR7/6)					
1900	Moderate orange	3	5.0	14.1	26.7	1.89
1038	(5YR6/8)					
2000	Moderate orange	3	7.5	10.0	20.3	2.04
1093	(2.5YR6/8)					
2100	Grayish reddish	6	10.0	6.5	14.1	2.16
1149	orange (2.5YR5/6)					
2200	Moderate reddish	7	12.5	1.5	3.4	2.26
1204	brown (2.5YR4/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

CAMBRIA COUNTY Munster Twp. Ebensburg quad.

Sample number **77-A-8**

Location: Exposure along the south side of U.S. Route 22, about 2800 feet (850 m) west of the town of Munster.

Latitude: 40°28'02"N

Longitude: 78°39'52"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Light-olive-gray to greenish-gray claystones grading stratigraphically down into clayey siltstones occur in this exposure. The claystones are massive, whereas the siltstones are thin bedded. The claystones crumble into small, hackly fragments; the siltstones break down into flaggy fragments. All are noncalcareous. The interiors of claystones are commonly weathered to a light to moderate olive brown.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	67.30	Quartz	32	Water of plasticity (%): 15.4
TiO ₂	0.96	Mica	39	Drying shrinkage (%): 5.0
Al ₂ O ₃	14.65	Kaolinite	8	Workability: Short
Fe ₂ O ₃	5.35	Chlorite-		Dry strength: Poor
MnO	0.064	vermiculite	0	Drying defects: None
MgO	1.12	Feldspar	1	pH: 7.3
CaO	0.39	Montmo-		
Na ₂ O	0.34	rillonite	20	
K ₂ O	2.48	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	13.7	25.9	1.89
982	(5YR7/8)					
1900	Moderate orange	3	5.0	12.4	24.1	1.95
1038	(5YR6/8)					
2000	Brownish orange	4	7.5	9.3	19.1	2.06
1093	(5YR5/8)					
2100	Brownish orange	6	7.5	7.0	14.9	2.10
1149	(2.5YR5/8)					
2200	Moderate reddish	7	7.5	3.7	7.8	2.13
1204	brown (2.5YR3/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Abrupt vitrification (2200-2300°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

CAMBRIA COUNTY Gallitzin Twp. Cresson quad.Sample number **77-B-7**

Location: Exposure along the north side of the Penn Central Railroad tracks, located about 1100 feet (340 m) south-southeast of the high school in Gallitzin.

Latitude: 40°28'37"N

Longitude: 78°33'14"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Olive-gray silty shales grading stratigraphically down to grayish-black carbonaceous shales. Silty shales break down into platy fragments; shales into papery fragments. All fragments have angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Composite through 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	62.50	Quartz	29	Water of plasticity (%): 18.5	
TiO ₂	1.05	Mica	59	Drying shrinkage (%): 5.0	
Al ₂ O ₃	18.10	Kaolinite	4	Workability: Short	
Fe ₂ O ₃	6.57	Chlorite-		Dry strength: Fair	
MnO	0.046	vermiculite	7	Drying defects: None	
MgO	1.37	Feldspar	1	pH: 5.1	
CaO	0.12	Montmo-			
Na ₂ O	0.20	rillonite	0		
K ₂ O	3.03	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	18.7	32.7	1.75
982	(5YR7/6)					
1900	Moderate orange	2	5.0	16.9	30.5	1.81
1038	(5YR7/6)					
2000	Moderate orange	3	7.5	13.6	26.0	1.91
1093	(5YR7/8)					
2100	Brownish orange	4	7.5	10.3	20.7	2.02
1149	(2.5YR5/8)					
2200	Moderate reddish	7	10.0	3.2	6.8	2.15
1204	brown (2.5YR4/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

*Munsell designation

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

CAMBRIA COUNTY Croyle Twp. Beaverdale quad.

Sample number **77-C-3**

Location: Exposure along the east side of Pa. Route 160, about 1 mile (1.6 km) south of Wilmore.

Latitude: 40°22'20"N

Longitude: 78°43'11"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Olive-brown thin-bedded silty shale is exposed for a stratigraphic interval of about 12 feet (4 m). Beds measure up to 2 inches (5.1 cm) in thickness. Silty shale breaks into platy to flaggy fragments having angular edges. All material is noncalcareous.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate to severe

Sampled interval: Composite sample through entire exposure

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	57.80	Quartz	21	Water of plasticity (%): 18.3
TiO ₂	1.03	Mica	63	Drying shrinkage (%): 5.0
Al ₂ O ₃	18.75	Kaolinite	0	Workability: Short
Fe ₂ O ₃	7.74	Chlorite-		Dry strength: Fair
MnO	0.068	vermiculite	9	Drying defects: None
MgO	2.32	Feldspar	7	pH: 7.1
CaO	0.41	Montmo-		
Na ₂ O	0.92	rillonite	0	
K ₂ O	3.13	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	16.6	30.1	1.82
982	(5YR7/6)					
1900	Moderate orange	3	5.0	14.1	26.7	1.90
1038	(2.5YR6/8)					
2000	Brownish orange	3	7.5	10.5	21.6	2.05
1093	(2.5YR5/8)					
2100	Grayish reddish	6	10.0	5.7	12.5	2.19
1149	orange (2.5YR5/6)					

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2200	Grayish reddish	7	10.0	1.4	3.1	2.20
1204	brown (2.5YR3/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

CAMBRIA COUNTY Adams Twp. Beaverdale quad.

Sample number **77-C-4**

Location: Strip pit operated by Cooney Bros. Coal Company, located about 5800 feet (1770 m) east-southeast of the village of Krayn.

Latitude: 40°15'43"N

Longitude: 78°42'29"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Medium-dark-gray to dark-gray claystone lies from 3-1/2 to 15-1/2 feet (1.1 to 4.7 m) stratigraphically above the Brookville coal. The Brookville coal at this location measures 42 inches (107 cm) in thickness and is overlain by a 32-inch (81-cm) underclay to an 8-inch (20-cm) coal. Beds range from 2 to 5 inches (5.1 to 12.7 cm) in thickness. A minor amount of iron staining occurs along fractures and bedding planes. The claystone is noncalcareous.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Composite through 12 stratigraphic feet (4 m)

Chemical analysis: **Mineralogy (X-ray):** **Raw properties:**

	%		%	
SiO ₂	64.40	Quartz	39	Water of plasticity (%): 18.3
TiO ₂	1.03	Mica	29	Drying shrinkage (%): 5.0
Al ₂ O ₃	16.80	Kaolinite	25	Workability: Short
Fe ₂ O ₃	4.76	Chlorite-		Dry strength: Fair
MnO	0.072	vermiculite	6	Drying defects: None
MgO	1.17	Feldspar	1	pH: 6.7
CaO	0.11	Montmo-		
Na ₂ O	0.16	rillonite	0	
K ₂ O	2.66	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Pale orange yellow	2	5.0	19.3	32.7	1.70
982	(7.5YR8/4)					
1900	Moderate yellowish	2	5.0	17.8	31.4	1.76
1038	pink (5YR8/4)					
2000	Moderate yellowish	3	5.0	15.7	28.6	1.82
1093	pink (5YR7/4)					
2100	Moderate orange	3	7.5	13.1	24.9	1.90
1149	(5YR7/6)					
2200	Light orange	7	10.0	5.2	11.2	2.17
1204	(5YR5/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

CAMBRIA COUNTY Adams Twp. Beaverdale quad.

Sample number 77-C-5

Location: Strip pit operated by the Cooney Bros. Coal Company, located about 7200 feet (2190 m) east-southeast of the village of Krayn.

Latitude: 40°15'33"N

Longitude: 78°42'16"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Olive-black to brownish-black underclay developed locally between an 8-inch (20-cm) coal seam and a 42-inch (107-cm) coal seam. The coals are believed to represent the Brookville horizon. The underclay contains some plant debris and is noncalcareous. It breaks down into hackly fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel through 32 inches (81 cm) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	64.30	Quartz	27	Water of plasticity (%): 18.9
TiO ₂	1.27	Mica	57	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.80	Kaolinite	11	Workability: Plastic
Fe ₂ O ₃	1.56	Chlorite-		Dry strength: Good
MnO	0.009	vermiculite	4	Drying defects: None
MgO	0.77	Feldspar	1	pH: 5.9
CaO	0.00	Montmo-		
Na ₂ O	0.14	rillonite	0	
K ₂ O	2.91	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Yellowish white	2	5.0	16.0	28.8	1.79
982	(10YR9/2)					
1900	Yellowish white	2	5.0	15.0	27.4	1.83
1038	(10YR9/2)					
2000	Yellowish white	3	5.0	13.3	25.1	1.88
1093	(10YR9/2)					
2100	Yellowish white	5	7.5	9.8	19.7	2.01
1149	(2.5Y9/2)					
2200	Grayish yellow	7	10.0	4.2	9.2	2.21
1204	(2.5Y8/4)					
2300	Yellowish gray	7	12.5	0.6	1.3	2.31
1260	(2.5Y8/2)					

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Recommended for extrusion. No effervescence when treated with HCl.

Potential uses: Structural tile (facing); stoneware.

*Munsell designation

CAMBRIA COUNTY Summerhill Twp. Beaverdale quad.

Sample number **77-C-6A**

Location: Strip pit operated by the Jooney Bros. Coal Company, located about 2 miles (3.2 km) southeast of the village of Germantown.

Latitude: 40°20'04"N

Longitude: 78°38'40"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium- to medium-dark-gray underclay is developed beneath a 10-inch (25-cm) coal seam which is believed to be the Middle Kittanning coal. The interval of underclay as sampled includes a very thin coal seam which is less than 1 inch (2.5 cm) thick and a 6-inch (15-cm) horizon in the underclay that contains some siderite nodules. Yellow-orange staining is evident in the siderite-bearing horizon.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 44 inches (112 cm) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	56.40	Quartz	21	Water of plasticity (%): 19.4
TiO ₂	1.35	Mica	42	Drying shrinkage (%): 7.5
Al ₂ O ₃	22.55	Kaolinite	35	Workability: Plastic
Fe ₂ O ₃	4.55	Chlorite-		Dry strength: Good
MnO	0.04	vermiculite	0	Drying defects: None
MgO	0.64	Feldspar	2	pH: 4.9
CaO	0.15	Montmo-		
Na ₂ O	0.18	rillonite	0	
K ₂ O	2.44	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light to mod. yel-	2	7.5	17.0	30.4	1.79
982	lowish pink (5YR8/4)					
1900	Pale orange yellow	2	7.5	15.8	29.1	1.84
1038	(7.5YR8/4)					
2000	Light to mod. orange	3	7.5	12.7	24.7	1.94
1093	yellow (7.5YR8/6)					
2100	Moderate orange yel-	6	10.0	9.2	19.0	2.07
1149	low (7.5YR7/6)					
2200	Light yellowish	7	12.5	2.6	5.7	2.19
1204	brown (10YR7/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Type FBS facing brick.

*Munsell designation

CAMBRIA COUNTY Summerhill Twp. Beaverdale quad.Sample number **77-C-6B**

Location: Strip pit operated by the Cooney Bros. Coal Company, located about 2 miles (3.2 km) southeast of the village of Germantown.

Latitude: 40°20'04"N

Longitude: 78°38'40"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium-dark-gray thin-bedded claystones that grade stratigraphically upwards into silty claystones are exposed for an interval of 12 feet (4 m) above the Middle Kittanning coal. Claystones are noncalcareous and show no evidence of iron staining.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Composite through 12 stratigraphic feet (4 m)**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	62.30	Quartz	36	Water of plasticity (%): 16.8
TiO ₂	0.89	Mica	31	Drying shrinkage (%): 5.0
Al ₂ O ₃	16.55	Kaolinite	27	Workability: Short
Fe ₂ O ₃	7.10	Chlorite-		Dry strength: Poor
MnO	0.119	vermiculite	0	Drying defects: None
MgO	1.35	Feldspar	4	pH: 6.6
CaO	0.34	Montmo-		
Na ₂ O	0.15	rillonite	2	
K ₂ O	2.57	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light to mod. yel-	2	7.5	15.9	29.3	1.84
982	lowish pink (5YR8/4)					
1900	Moderate yellowish	2	7.5	15.4	28.7	1.86
1038	pink (5YR7/4)					
2000	Light reddish brown	3	7.5	12.9	25.2	1.95
1093	(2.5YR6/4)					
2100	Grayish reddish	4	7.5	10.8	21.7	2.01
1149	orange (2.5YR5/6)					
2200	Grayish brown	7	10.0	4.5	9.9	2.18
1204	(5YR4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative

*Munsell designation

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

CAMBRIA COUNTY Reade Twp. Blandburg quad.

Sample number **86-A-3A**

Location: Stripping operated by Cambria Coal, located about 6500 feet (1980 m) east-northeast of the village of Van Ormer.

Latitude: 40°40'42"N

Longitude: 78°28'14"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Medium-light-gray claystone grades down into greenish-gray clayey siltstone under a limestone bed that is believed to represent the Upper Freeport limestone. The Upper Freeport coal occurs about 13 feet (4 m) above the limestone. The claystone is slightly calcareous below the limestone, but becomes noncalcareous with depth. Some brownish iron staining occurs along fractures. Fragments of the sampled interval range from hackly to slabby.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Composite through 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	59.00	Quartz	24	Water of plasticity (%): 19.0	
TiO ₂	1.10	Mica	65	Drying shrinkage (%): 5.0	
Al ₂ O ₃	19.15	Kaolinite	5	Workability: Plastic	
Fe ₂ O ₃	4.60	Chlorite-		Dry strength: Fair	
MnO	0.069	vermiculite	4	Drying defects: None	
MgO	2.21	Feldspar	2	pH: 7.9	
CaO	2.48	Montmo-			
Na ₂ O	0.18	rillonite	0		
K ₂ O	3.02	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Pale orange yellow	3	5.0	16.7	30.0	1.80
982	(7.5YR8/4)					
1900	Moderate orange	3	5.0	14.1	26.8	1.90
1038	(5YR7/6)					
2000	Light brown to mod.	4	7.5	11.7	23.0	1.97
1093	orange (5YR6/6)					

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2100	Light brown to mod.	7	10.0	8.0	16.8	2.11
1149	orange (5YR6/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). Slight effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

CAMBRIA COUNTY Reade Twp. Blandburg quad.

Sample number **86-A-3B**

Location: Stripping operated by Cambria Coal, located about 6500 feet (1980 m) east-northeast of the village of Van Ormer.

Latitude: 40°40'42"N

Longitude: 78°28'14"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-dark-gray, dark-gray, and some dark-greenish-gray claystones grade upward stratigraphically into silty claystones and clayey siltstones from 0 to 20 feet (0 to 6 m) above the Upper Freeport coal. Silty beds are commonly less than 1 inch (2.5 cm) thick, whereas claystone beds appear to range from 3 to 6 inches (7.6 to 15 cm) in thickness. Iron staining is present along fractures. Fragments are commonly tabular to splintery.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Composite of 20 stratigraphic feet (6 m)

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	64.20	Quartz	31	Water of plasticity (%): 16.8
TiO ₂	0.97	Mica	52	Drying shrinkage (%): 5.0
Al ₂ O ₃	17.10	Kaolinite	11	Workability: Short
Fe ₂ O ₃	5.13	Chlorite-		Dry strength: Fair
MnO	0.072	vermiculite	2	Drying defects: None
MgO	1.52	Feldspar	4	pH: 7.7
CaO	0.29	Montmo-		
Na ₂ O	0.16	rillonite	0	
K ₂ O	3.02	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Moderate orange	3	7.5	14.4	26.9	1.88
982	(5YR7/6)					
1900	Moderate orange	3	7.5	13.1	25.3	1.93
1038	(5YR7/6)					
2000	Moderate orange	4	7.5	11.2	22.4	2.00
1093	(5YR6/8)					
2100	Brownish orange	4	7.5	9.3	19.2	2.06
1149	(2.5YR5/8)					
2200	Moderate brown	7	10.0	3.3	7.3	2.23
1204	(5YR4/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.**Potential uses:** Grade SW building brick.

*Munsell designation

CAMBRIA COUNTY Dean Twp. Altoona quad.Sample number **86-C-2A****Location:** Stripping operated by the Cooney Bros. Coal Company, located about 4000 feet (1220 m) west of the village of Richland.**Latitude:** 40°35'51"N**Longitude:** 78°29'58"W**Geologic unit:** Kittanning Formation, Allegheny Group**Description:** Medium-gray noncalcareous underclay to the Middle Kittanning coal is exposed for a thickness of 24 inches (61 cm). When weathered, the underclay is orange tan or brown in color.**Attitude of bedding:** N40E, 5NW**Weathering intensity:** Slight to moderate**Sampled interval:** Channel through 24 inches (61 cm)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	68.20	Quartz	46	Water of plasticity (%): 20.1
TiO ₂	1.01	Mica	40	Drying shrinkage (%): 5.0
Al ₂ O ₃	16.40	Kaolinite	13	Workability: Plastic
Fe ₂ O ₃	3.93	Chlorite-		Dry strength: Good
MnO	0.019	vermiculite	0	Drying defects: None
MgO	0.62	Feldspar	1	pH: 7.1
CaO	0.12	Montmo-		
Na ₂ O	0.15	rillonite	0	
K ₂ O	2.74	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light to mod. yellow-	2	5.0	16.2	28.9	1.79
982	ish pink (5YR8/4)					
1900	Light to mod. yellow-	3	5.0	15.0	27.5	1.83
1038	ish pink (5YR8/4)					
2000	Mod. yellowish pink to	3	5.0	13.4	25.4	1.89
1093	mod. orange (5YR7/6)					
2100	Mod. orange to light	4	7.5	10.9	21.3	1.95
1149	brown (5YR6/6)					
2200	Light brown	7	10.0	3.9	8.5	2.20
1204	(5YR6/4)					
2300	Grayish yellowish	7	12.5	1.4	3.1	2.23
1260	brown (10YR5/2)					

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: High shrinkage at 2300°F. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; stoneware.

*Munsell designation

CAMBRIA COUNTY Dean Twp. Altoona quad.

Sample number **86-C-2B**

Location: Strip pit operated by the Cooney Bros. Coal Company, located about 4000 feet (1220 m) west of the village of Richland.

Latitude: 40°35'51"N

Longitude: 78°29'58"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Grayish-black thin-bedded claystone occurs for an interval estimated to be between 30 and 40 stratigraphic feet (9 and 12 m) above the Middle Kittanning coal. Beds are commonly from 1 to 4 inches (2.5 to 10.2 cm) thick. Some siderite nodules occur in the lower part of the interval. Iron staining is slight. Fragments of claystone are commonly slabby and have angular edges.

Attitude of bedding: N40E, 5NW

Weathering intensity: Slight

Sampled interval: Channel through 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	52.70	Quartz	17	Water of plasticity (%): 17.8
TiO ₂	0.89	Mica	55	Drying shrinkage (%): 5.0
Al ₂ O ₃	21.95	Kaolinite	21	Workability: Short
Fe ₂ O ₃	7.90	Chlorite-		Dry strength: Poor
MnO	0.172	vermiculite	0	Drying defects: None
MgO	1.70	Feldspar	3	pH: 7.0
CaO	0.39	Montmo-		
Na ₂ O	0.22	rillonite	4	
K ₂ O	4.07	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color*</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Moderate yellowish	3	5.0	15.1	28.2	1.87
982	pink (5YR7/4)					
1900	Moderate yellowish	3	5.0	11.0	22.2	2.01
1038	pink (2.5YR7/4)					
2000	Light reddish brown	6	5.0	7.2	15.6	2.16
1093	(2.5YR6/4)					
2100	Light reddish brown	7	10.0	5.4	11.7	2.18
1149	(2.5YR5/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

FAYETTE COUNTY Brownsville Twp. California quad.Sample number **28-C-7**

Location: Exposure along the northeast side of the U.S. Route 40 bypass, about 2900 feet (880 m) southeast of the point where U.S. Route 40 passes the east bank of the Monongahela River.

Latitude: 40°01'13"N

Longitude: 79°52'32"W

Geologic unit: Uniontown Formation, Monongahela Group

Description: Medium-gray shaly siltstone occurs above the Uniontown(?) coal in the exposure. The siltstone beds are thickly laminated to very thinly bedded, ranging from about 1/8 inch to 3/8 inch (0.3 to 1 cm) in thickness. They break down to form platy or flaggy fragments. Siderite nodules and thin bands occur in the sampled interval, making up about 3 to 4 percent of the section by volume. Locally the interval is calcareous.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Channel sample through 9 stratigraphic feet (2.7 m)**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	53.9	Quartz	21	Water of plasticity (%): 17.0
TiO ₂	0.89	Mica	54	Drying shrinkage (%): 0.0
Al ₂ O ₃	19.45	Kaolinite	17	Workability: Short
Fe ₂ O ₃	6.52	Chlorite-		Dry strength: Poor
MnO	0.065	vermiculite	7	Drying defects: None
MgO	1.60	Feldspar	1	pH: 8.0
CaO	0.84	Montmo-		
Na ₂ O	0.47	rillonite	0	
K ₂ O	3.43	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
800	Tan	3	2.5	16.7	30.1	1.81
982						
1900	Orange tan	4	5.0	11.4	22.7	1.99
2038						
2000	Orange tan	6	10.0	8.3	17.3	2.09
2093						
2100	Light brown	6	10.0	5.2	11.0	2.10
2149						
2200	--	--	Expanded	--	--	--
2204						

Pyrometric cone equivalent: ND**Bloating test:** Positive

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	1.88	117.3	12.1	No expansion.
982				
1900	1.75	109.0	12.3	No expansion.
1038				
2000	1.41	87.7	9.8	Mostly laminar expansion.
1093				
2100	1.11	69.3	8.2	Mixed bloated and un-
1149				bloated.
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for use in lightweight aggregate (mixture of bloating and nonbloating materials). Poor colors in slow-firing tests.

Potential uses: Grade SW building brick.

FAYETTE COUNTY Perry Twp. Fayette City quad.

Sample number 28-D-8A

Location: Exposure along the east side of Pa. Route 51, about 3300 feet (1010 m) south of the village of Wickhaven.

Latitude: 40°06'48"N**Longitude:** 79°46'20"W

Geologic unit: Uniontown Formation, Monongahela Group

Description: Medium-gray to black underclay to an 11-inch (28-cm) coal seam occurs about 15 feet (4.5 m) above the road level. The black underclay contains sulfur stains and is directly under the coal seam. The coal is probably the Little Waynesburg coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 15 inches (38 cm) of underclay

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	<i>%</i>		<i>%</i>	
SiO ₂	57.80	Quartz	21	Water of plasticity (%): 21.0
TiO ₂	1.01	Mica	52	Drying shrinkage (%): 2.5
Al ₂ O ₃	22.30	Kaolinite	23	Workability: Plastic
Fe ₂ O ₃	5.05	Chlorite-		Dry strength: Good
MnO	0.026	vermiculite	1	Drying defects: None
MgO	1.20	Feldspar	1	pH: 4.1

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	0.08	Montmo-	
Na ₂ O	0.38	rillonite	2
K ₂ O	3.38	Calcite	0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	5.0	26.4	40.7	1.54
982						
1900	Tan	2	5.0	23.0	37.7	1.64
1038						
2000	Orange tan	5	10.0	14.4	26.9	1.87
1093						
2100	Light red	6	12.5	8.7	17.7	2.03
1149						
2200	Red brown	7	15.0	7.3	13.6	1.86
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Good color at 2200°F. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates.

FAYETTE COUNTY Perry Twp. Fayette City quad.

Sample number 28-D-8B

Location: Exposure along the east side of Pa. Route 51, about 3300 feet (1010 m) south of the village of Wickhaven.

Latitude: 40°06'48"N

Longitude: 79°46'20"W

Geologic unit: Uniontown Formation, Monongahela Group

Description: Medium-dark-gray to brownish-black, interbedded silty shales and shales occur below the underclay collected as sample 28-D-8A. Beds range in thickness from 1/4 inch (0.6 cm) up to about 6 inches (15 cm). Shales break into platy and flaggy fragments. Weathered surfaces of shales are very pale to dark yellowish orange and moderate brown. Base of sampled interval is at road level; hence, full thickness of unit is not known.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel sample through 8 stratigraphic feet (2.4 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	52.90	Quartz	21	Water of plasticity (%): 19.1
TiO ₂	0.92	Mica	61	Drying shrinkage (%): 2.5
Al ₂ O ₃	17.75	Kaolinite	9	Workability: Short
Fe ₂ O ₃	8.50	Chlorite-		Dry strength: Poor
MnO	0.109	vermiculite	2	Drying defects: None
MgO	1.32	Feldspar	4	pH: 4.7
CaO	0.27	Montmo-		
Na ₂ O	0.53	rillonite	3	
K ₂ O	2.93	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	24.8	40.0	1.61
982						
1900	Tan	3	7.5	20.1	35.0	1.74
1038						
2000	Light brown	5	10.0	14.3	27.0	1.89
1093						
2100	Red brown	6	10.0	10.7	21.7	2.03
1149						
2200	Red brown	7	10.0	6.4	13.6	2.14
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Good color at 2100°F in slow-firing tests. No effervescence when the material is treated with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	2.16	134.9	7.5	No expansion.
982				
1900	1.71	106.5	11.3	Laminar expansion.
1038				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2000	1.64	102.3	12.6	Laminar expansion.
1093				
2100	1.15	71.5	12.5	Good pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates; promising raw material for lightweight aggregate.

FAYETTE COUNTY German Twp. New Salem quad.

Sample number **29-B-3**

Location: Exposure along the north side of Pa. Route 21, about 13,000 feet (3960 m) west of the village of Revere.

Latitude: 39°53'34"N

Longitude: 79°50'09"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Brownish-black to dark-gray, fissile shale is exposed for a stratigraphic distance of 7 feet (2.1 m) above road level. Sandy beds overlie the shale. Siderite nodules occur in the shale interval about 2 feet (0.6 m) below the contact between shale and sandstone. Iron staining, yellow-brown to brown in color, occurs along fractures in the shale. The shale breaks into papery-shaped fragments.

Attitude of bedding: NE-SW, 4NW

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 7 stratigraphic feet (2.1 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	53.80	Quartz	19	Water of plasticity (%): 17.6
TiO ₂	1.05	Mica	55	Drying shrinkage (%): 5.0
Al ₂ O ₃	18.90	Kaolinite	17	Workability: Short
Fe ₂ O ₃	8.31	Chlorite-		Dry strength: Fair
MnO	0.153	vermiculite	6	Drying defects: None
MgO	1.66	Feldspar	3	pH: 7.3
CaO	0.71	Montmo-		
Na ₂ O	0.19	rillonite	0	
K ₂ O	3.22	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	19.4	34.1	1.76
982						
1900	Tan	3	5.0	16.6	30.8	1.86
1038						
2000	Light brown	5	10.0	10.5	21.6	2.05
1093						
2100	Red brown	6	10.0	6.5	14.3	2.21
1149						
2200	Dark brown	7	10.0	2.0	4.5	2.32
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	1.84	114.7	10.4	No expansion.
982				
1900	1.41	87.8	10.2	Laminar expansion.
1038				
2000	1.15	71.8	15.2	Mixed bloated and un-
1093				bloated.
2100	1.04	64.9	19.0	Some lumps melted.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for use in lightweight aggregate (mixture of bloating and nonbloating materials).

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates.

FAYETTE COUNTY Menallen Twp. New Salem quad.Sample number **29-B-6****Location:** Strip mine operated by Carbonara Coal Company, located about 600 feet (180 m) north of the village of Dearth.**Latitude:** 39°56'38"N**Longitude:** 79°47'44"W**Geologic unit:** Pittsburgh Formation, Monongahela Group**Description:** Dark-gray to grayish-black shales grade upward into medium-dark-gray to medium-gray mudstones and silty shales. Locally lenses and nodules of siderite, measuring up to 3/4 inch (1.9 cm) in thickness, occur in the sampled interval. Calcareous throughout the upper half of the interval, locally in the lower half. Redstone coal occurs at lower contact of sampled interval. Approximately 10 feet (3 m) of mudstones continue above sampled interval. Iron staining is present along fractures.**Attitude of bedding:** Slight dip (approx. 2°) to the west-northwest**Weathering intensity:** Moderate to slight**Sampled interval:** Channel sample through 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	48.10	Quartz	15	Water of plasticity (%): 20.2
TiO ₂	0.76	Mica	43	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.40	Kaolinite	14	Workability: Plastic
Fe ₂ O ₃	5.55	Chlorite-		Dry strength: Good
MnO	0.10	vermiculite	0	Drying defects: None
MgO	2.82	Feldspar	1	pH: 7.3
CaO	3.78	Montmo-		
Na ₂ O	0.23	rillonite	20	
K ₂ O	3.44	Calcite	1	
		Dolomite	5	
		Goethite	1	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Tan	6	10.0	13.8	26.7	1.93
982						
1900	Tan	6	10.0	12.7	25.0	1.97
1038						
2000	Light brown	6.5	12.5	7.2	15.4	2.14
1093						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2100	Medium brown	6.5	12.5	4.3	9.4	2.19
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Poor colors in slow-firing tests. Is probably limy.

Potential uses: Grade SW building brick; drain tile.

FAYETTE COUNTY Nicholson Twp. Masontown quad.

Sample number 29-C-4A

Location: Strip mine operated by the Geneva Construction Company, located about 7000 feet (2130 m) northeast of the village of New Geneva.

Latitude: 39°48'08"N Longitude: 79°53'32"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Olive-black to brownish-black, fissile shales occur above the Sewickley coal. The shale forms papery fragments when broken. The upper contact of the sampled interval is defined by a sandstone bed. The lower 4 feet (1.2 m) of the sampled interval effervesces when treated with hydrochloric acid.

Attitude of bedding: Dip is a few degrees to the west-northwest

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 9 stratigraphic feet (2.7 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	51.00	Quartz	27	Water of plasticity (%): 17.5
TiO ₂	0.91	Mica	47	Drying shrinkage (%): 2.5
Al ₂ O ₃	19.20	Kaolinite	5	Workability: Plastic
Fe ₂ O ₃	6.40	Chlorite-		Dry strength: Good
MnO	0.128	vermiculite	10	Drying defects: None
MgO	2.22	Feldspar	2	pH: 7.1
CaO	3.12	Montmo-		
Na ₂ O	0.29	rillonite	0	
K ₂ O	3.23	Calcite	3	
		Gypsum	6	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	4	5.0	18.1	32.5	1.80
982						
1900	Tan	5	7.5	12.8	25.4	1.99
1038						
2000	Light brown	5	10.0	9.3	19.4	2.08
1093						
2100	Dark brown	6.5	10.0	4.1	9.2	2.26
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Positive**Remarks:** Poor colors in slow-firing tests.**Bloating tests (quick-firing):**

Crushing characteristics: Platy

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	1.97	122.7	9.3	No expansion.
982				
1900	1.51	94.1	8.9	Laminar expansion.
1038				
2000	1.26	78.6	12.9	Slight bloating.
1093				
2100	0.78	48.9	13.3	Fair pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Potential uses: Grade SW building brick; Type H floor brick; promising raw material for lightweight aggregate.**FAYETTE COUNTY Nicholson Twp. Masontown quad.**Sample number **29-C-4B****Location:** Strip mine operated by the Geneva Construction Company, located about 7000 feet (2130 m) northeast of the village of New Geneva.**Latitude:** 39°47'57"N**Longitude:** 79°53'28"W**Geologic unit:** Pittsburgh Formation, Monongahela Group

Description: Dark-gray claystone occurs above the Redstone coal. Some carbonaceous trash is present in the claystone. Claystone commonly forms platy fragments when broken. Locally iron stains occur along fractures. No effervescence when treated with dilute hydrochloric acid.

Attitude of bedding: Dip is a few degrees to the west-northwest

Weathering intensity: Slight

Sampled interval: Channel sample through 10 stratigraphic feet (3 m)

Chemical analysis:

	%
SiO ₂	52.45
TiO ₂	0.82
Al ₂ O ₃	20.65
Fe ₂ O ₃	6.81
MnO	0.114
MgO	1.48
CaO	0.56
Na ₂ O	0.24
K ₂ O	3.38

Mineralogy (X-ray):

	%
Quartz	15
Mica	55
Kaolinite	24
Chlorite-vermiculite	2
Feldspar	4
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 17.2
Drying shrinkage (%): 5.0
Workability: Short
Dry strength: Poor
Drying defects: None
pH: 7.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	4	5.0	15.8	29.8	1.88
982						
1900	Tan	5	10.0	13.2	26.2	1.98
1038						
2000	Light brown	6	10.0	7.7	16.7	2.17
1093						
2100	Red brown	6	10.0	4.6	10.4	2.27
1149						
2200	Dark brown	7	10.0	3.2	7.0	2.21
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	1.76	109.9	9.2	No expansion.
982				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1900	1.55	96.6	9.9	Laminar expansion.
1038				
2000	1.16	72.3	12.4	Mixed bloated and non-
1093				bloated.
2100	0.96	59.9	22.1	Overbloated, fused.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for use in lightweight aggregate (mixture of low- and high-temperature bloating materials).

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe.

FAYETTE COUNTY Springhill Twp. Masontown quad.

Sample number **29-C-5**

Location: Exposure along the north side of Pa. Route 166, about 2500 feet (760 m) by road west of the village of Sprucetown.

Latitude: 39°45'14"N

Longitude: 79°52'33"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Yellowish-gray and grayish-red, very thin bedded silty shales, probably from the Birmingham shale horizon, occur in this exposure. The shale breaks into small platy fragments having angular edges. Iron staining is common along joints. Minor amount of siderite occurs as nodules in the sampled interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	51.90	Quartz	19	Water of plasticity (%): 21.0
TiO ₂	0.88	Mica	59	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.50	Kaolinite	13	Workability: Plastic
Fe ₂ O ₃	9.15	Chlorite-		Dry strength: Fair
MnO	0.107	vermiculite	0	Drying defects: None
MgO	1.81	Feldspar	3	pH: 7.6
CaO	0.92	Montmo-		
Na ₂ O	0.27	rillonite	6	
K ₂ O	3.29	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800 982	Tan	5	10.0	15.8	29.7	1.88
1900 1038	Orange tan	5	10.0	5.8	12.9	2.23
2000 1093	Light brown	7	15.0	3.6	8.5	2.24
2100 1149	Red brown	7	15.0	3.5	8.1	2.39
2200 1204	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Poor color. Slightly calcareous in the upper 3 feet (0.9 m) of the channel sample.

Potential uses: Grade MW building brick.

FAYETTE COUNTY North Union Twp. Uniontown quad.

Sample number 39-A-1A

Location: Pennsylvania Department of Transportation core hole B4, Station 177 + 57 along LR 1058, Section 1, located about 7000 feet (2130 m) north-northeast of the courthouse in Uniontown.

Latitude: 39°55'11"N

Longitude: 79°43'04"W

Geologic unit: Waynesburg Formation, Dunkard Group

Description: Olive-black silty shale interval occurs above an 8-inch (20-cm) bony coal which might be the Waynesburg "B" seam. The silty shale was penetrated by the drill between 6 and 12 feet (1.8 and 3.7 m) of depth in the hole. Weathering of the silty shale was evident by the change in colors to reddish brown and dark yellowish orange. Locally, the core effervesced when treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Entire core from 6 to 12 feet (1.8 to 3.7 m) in depth

Chemical analysis:	Mineralogy (X-ray):	Raw properties:
%	%	
SiO ₂	Quartz	Water of plasticity (%): 19.3
TiO ₂	Mica	Drying shrinkage (%): 2.5
Al ₂ O ₃	Kaolinite	Workability: Short
Fe ₂ O ₃	Chlorite-	Dry strength: Poor
MnO	vermiculite	Drying defects: None
MgO	Feldspar	pH: 7.6
CaO	Montmo-	
Na ₂ O	rillonite	
K ₂ O	Calcite	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	19.6	34.1	1.74
982						
1900	Tan	3	5.0	17.9	32.1	1.80
1038						
2000	Light brown	3	5.0	17.6	31.8	1.80
1093						
2100	Light red	4	7.5	14.6	28.2	1.94
1149						
2200	Dark red	4	7.5	9.9	20.0	2.01
1204						
2300	Dark red	6.5	10.0	6.0	12.5	2.07
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Good color at 2200°F.

Potential uses: Grade SW building brick; Type FBX facing brick; Type T floor brick.

FAYETTE COUNTY North Union Twp. Uniontown quad.

Sample number **39-A-1B**

Location: Pennsylvania Department of Transportation core hole B4, Station 177 + 57 along LR 1058, Section 1, located about 7000 feet (2130 m) north-northeast of the courthouse in Uniontown.

Latitude: 39°55'11"N

Longitude: 79°43'04"W

Geologic unit: Waynesburg Formation, Dunkard Group

Description: Medium- to dark-gray, calcareous, shaly siltstone was penetrated in the core hole between the depths of 14.8 and 22.2 feet (4.5 and 6.8 m). This interval is stratigraphically above a coal which might be the Waynesburg "A" seam.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Entire core between depths of 14.8 and 22.2 feet (4.5 and 6.8 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	67.55	Quartz	38	Water of plasticity (%)	16.2
TiO ₂	0.89	Mica	39	Drying shrinkage (%)	5.0
Al ₂ O ₃	14.45	Kaolinite	9	Workability	Short
Fe ₂ O ₃	5.80	Chlorite-		Dry strength	Poor
MnO	0.083	vermiculite	2	Drying defects	None
MgO	1.17	Feldspar	9	pH	8.1
CaO	0.34	Montmo-			
Na ₂ O	0.83	rillonite	2		
K ₂ O	2.25	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	2	5.0	16.3	30.0	1.84
982						
1900	Tan	2	5.0	16.0	30.0	1.86
1038						
2000	Light brown	3	5.0	15.2	28.6	1.88
1093						
2100	Light brown	5	5.0	11.4	23.4	2.05
1149						
2200	Dark brown	6	7.5	7.5	16.2	2.15
1204						
2300	Gray green	6	10.0	2.8	5.8	2.09
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Poor colors.

Potential uses: Grade SW building brick; Type FBA facing brick.

FAYETTE COUNTY Dunbar Twp. Uniontown quad.

Sample number **39-A-5A**

Location: Exposure along the southeast side of U.S. Route 119, about 1 mile (1.6 km) due east of the village of Monarch.

Latitude: 39°58'46"N

Longitude: 79°38'02"W

Geologic unit: Waynesburg Formation, Dunkard Group

Description: Medium-gray to medium-dark-gray underclay to a 7-inch (18-cm) coal seam occurs in the exposure. The coal may be the Waynesburg "A" coal. The underclay is 2-1/2 feet (0.8 m) thick and, when broken, forms hackly fragments. Brown iron stains occur along fractures in the underclay. Silty shale is present beneath the underclay.

Attitude of bedding: Dips gently (a few degrees) to the northwest**Weathering intensity:** Slight to moderate**Sampled interval:** Channel through 2-1/2 feet (0.8 m) of underclay**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	61.50	Quartz	34	Water of plasticity (%): 18.7
TiO ₂	1.07	Mica	52	Drying shrinkage (%): 2.5
Al ₂ O ₃	20.05	Kaolinite	19	Workability: Short
Fe ₂ O ₃	5.35	Chlorite-		Dry strength: Fair
MnO	0.024	vermiculite	0	Drying defects: None
MgO	0.91	Feldspar	5	pH: 3.6
CaO	0.09	Montmo-		
Na ₂ O	0.40	rillonite	0	
K ₂ O	3.15	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	22.2	37.2	1.67
982						
1900	Tan	3	5.0	19.0	33.3	1.75
1038						
2000	Orange tan	6	7.5	14.0	26.8	1.92
1093						
2100	Light red	6	10.0	8.1	17.1	2.11
1149						
2200	Dark red	7	15.0	5.6	12.1	2.17
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Fair color at 2200°F. No effervescence when treated with HCl.**Potential uses:** Grade SW building brick; Type FBS facing brick; Type H floor brick.

FAYETTE COUNTY Dunbar Twp. Uniontown quad.Sample number **39-A-5B****Location:** Exposure along the south side of U.S. Route 119, about 1 mile (1.6 km) due east of the village of Monarch.**Latitude:** 39°58'46"N**Longitude:** 79°38'02"W**Geologic unit:** Waynesburg Formation, Dunkard Group**Description:** Dark-gray to dark-black, fissile shale occurs above a 7-inch (18-cm) coal, the latter probably the Waynesburg "A." A terrace has been cut on the shale, restricting the exposure of shale to 3 feet (0.9 m). The shale is noncalcareous. Iron staining in minor amounts is present.**Attitude of bedding:** Dips gently (a few degrees) to the northwest**Weathering intensity:** Slight**Sampled interval:** Channel through 3 stratigraphic feet (0.9 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	46.70	Quartz	17	Water of plasticity (%): 17.6
TiO ₂	0.84	Mica	61	Drying shrinkage (%): 2.5
Al ₂ O ₃	19.65	Kaolinite	5	Workability: Short
Fe ₂ O ₃	7.13	Chlorite-		Dry strength: Poor
MnO	0.026	vermiculite	5	Drying defects: None
MgO	1.10	Feldspar	2	pH: 4.3
CaO	0.21	Montmo-		
Na ₂ O	0.25	rillonite	0	
K ₂ O	3.04	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Tan	4	5.0	31.3	45.6	1.46
982						
1900	Tan	4	5.0	25.0	40.0	1.60
1038						
2000	Orange tan	4	10.0	18.8	32.2	1.71
1093						
2100	Red tan	5	10.0	13.2	24.6	1.86
1149						
2200	Light brown	7	10.0	12.3	23.6	1.93
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative**Remarks:** Poor colors. Abrupt vitrification (2000-2300°F).**Potential uses:** Grade SW building brick; drain tile.

FAYETTE COUNTY Dunbar Twp. South Connellsville quad.Sample number **39-B-6****Location:** Quarry on the northwest side of U.S. Route 119, about 3000 feet (910 m) north-northeast of the village of Sitka.**Latitude:** 39°59'57"N**Longitude:** 79°36'29"W**Geologic unit:** Pittsburgh Formation, Monongahela Group**Description:** Interbedded, thickly laminated silty shales and shales occur beneath a 4- to 5-foot (1.2- to 1.5-m) soil developed at the top of the quarry. Beds average about 1/4 inch (0.6 cm) in thickness. Weathering is moderate to severe; surfaces of the shales are colored yellow oranges and browns. Unweathered parts of the shales are olive colors. Shales are noncalcareous in the sampled interval. Interbedded silty shales and sandstones occur in the lower part of the quarry. Exposed section is probably above the Redstone coal.**Attitude of bedding:** Beds dip about 5 degrees to the northwest**Weathering intensity:** Moderate to severe**Sampled interval:** Seven stratigraphic feet (2.1 m) was channel sampled**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	58.60	Quartz	25	Water of plasticity (%): 21.4
TiO ₂	1.07	Mica	54	Drying shrinkage (%): 5.0
Al ₂ O ₃	21.05	Kaolinite	14	Workability: Plastic
Fe ₂ O ₃	7.46	Chlorite-		Dry strength: Fair
MnO	0.116	vermiculite	3	Drying defects: None
MgO	1.10	Feldspar	4	pH: 8.6
CaO	0.23	Montmo-		
Na ₂ O	0.18	rillonite	0	
K ₂ O	3.18	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	5.0	17.2	31.6	1.84
982						
1900	Tan	3	5.0	16.0	30.0	1.88
1038						
2000	Orange tan	5	10.0	11.2	23.0	2.05
1093						
2100	Light brown	5	10.0	7.5	16.2	2.16
1149						
2200	Red brown	7	10.0	4.6	10.3	2.22
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: Fair color at 2200°F.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe.

FAYETTE COUNTY South Union Twp. Brownfield quad.

Sample number **39-C-2A**

Location: Pennsylvania Department of Transportation core hole C702 at LR 1058, section 4, station 505 + 54, offset 25 feet (7.6 m) left, located several hundred feet southeast of the village of Meadowbrook.

Latitude: 39°52'17"N

Longitude: 79°42'51"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Medium- to dark-gray, calcareous shales and silty shales were penetrated between depths of 15.5 and 22 feet (4.7 and 7 m). A 1.5-inch (3.8-cm) band of sandstone occurs in the sequence at a depth of 19.5 feet (5.9 m). Yellow and orange iron staining is present along the bedding planes.

Attitude of bedding: N35E, 5W

Weathering intensity: Slight to moderate

Sampled interval: Entire core between 15.5 and 22 feet (4.7 and 7 m) in depth

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	55.80	Quartz	20	Water of plasticity (%): 13.3
TiO ₂	1.00	Mica	47	Drying shrinkage (%): 2.5
Al ₂ O ₃	18.70	Kaolinite	28	Workability: Short
Fe ₂ O ₃	9.18	Chlorite-		Dry strength: Poor
MnO	0.128	vermiculite	0	Drying defects: None
MgO	1.44	Feldspar	1	pH: 8.0
CaO	0.44	Montmo-		
Na ₂ O	0.14	rillonite	3	
K ₂ O	2.87	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	2	5.0	18.4	33.3	1.81
982						
1900	Beige	3	5.0	16.9	31.3	1.86
1038						
2000	Beige	3	5.0	14.0	27.6	1.97
1093						
2100	Light brown	4	5.0	11.1	23.5	2.12
1149						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2200	Chocolate brown	6	7.5	7.2	15.9	2.20
1204						
2300	Dark brown	6	10.0	5.3	11.4	2.16
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor colors.

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	2.07	129.1	8.0	No expansion.
982				
1900	1.54	96.0	10.3	Mixed bloating and non-bloating.
1038				
2000	1.23	76.7	15.9	Mixed bloating and non-bloating.
1093				
2100	0.84	52.4	18.7	Mixed overbloomed and underbloomed.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for use in lightweight aggregate (mixture of low- and high-temperature bloating materials).

Potential uses: Grade SW building brick; Type FBA facing brick; drain tile.

FAYETTE COUNTY South Union Twp. Brownfield quad.

Sample number 39-C-2B

Location: Pennsylvania Department of Transportation core hole C702 at LR 1058, Section 4, Station 505 + 54, offset 25 feet (7.6 m) left, located several hundred feet southeast of the village of Meadowbrook.

Latitude: 39°52'17"N

Longitude: 79°42'51"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Carbonaceous shale occurs at a depth of 22 to 24.5 feet (6.7 to 7.5 m) in the drill hole and stratigraphically above a 3.5-foot- (1.1-m) thick coal seam. The coal is probably the Pittsburgh rider coal. Some yellow-orange iron staining is present along joints in the shale.

Attitude of bedding: N35E, 5W

Weathering intensity: Slight

Sampled interval: Entire core from depths of 22 to 24.5 feet (6.7 to 7.5 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	41.60	Quartz	13	Water of plasticity (%): 17.4	
TiO ₂	0.90	Mica	60	Drying shrinkage (%): 5.0	
Al ₂ O ₃	19.95	Kaolinite	25	Workability: Plastic	
Fe ₂ O ₃	7.72	Chlorite-		Dry strength: Fair	
MnO	0.082	vermiculite	0	Drying defects: None	
MgO	0.68	Feldspar	1	pH: 4.2	
CaO	0.51	Montmo-			
Na ₂ O	0.17	rillonite	0		
K ₂ O	2.19	Calcite	0		

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Orange tan	2	5.0	32.5	46.9	1.44
982						
1900	Orange tan	2	7.5	30.2	45.5	1.51
1038						
2000	Light brown	3	7.5	22.9	38.0	1.66
1093						
2100	Red brown	5	10.0	16.4	31.3	1.91
1149						
2200	Dark brown	6	10.0	11.2	22.4	2.00
1204						
2300	Dark brown	6	12.5	7.8	15.8	2.02
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Fair color at 2100°F. No effervescence when treated with HCl.

Potential uses: Grade MW building brick; Type FBS facing brick; drain tile.

FAYETTE COUNTY South Union Twp. Brownfield quad.

Sample number **39-C-2C**

Location: Pennsylvania Department of Transportation core hole C702 at LR 1058, Section 4, Station 505 + 54, offset 25 feet (7.6 m) left, located several hundred feet southeast of the village of Meadowbrook.

Latitude: 39°52'17"N

Longitude: 79°42'51"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Medium-light-gray to medium-gray, noncalcareous underclay to the Pittsburgh coal was penetrated at a depth of 44 to 45.5 feet (13 to 13.9 m) in the drill hole.

Attitude of bedding: N35E, 5W

Weathering intensity: Negligible

Sampled interval: Entire core between depths of 44 and 45.5 feet (13 and 13.9 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	57.30	Quartz	21	Water of plasticity (%): 25.0
TiO ₂	0.91	Mica	37	Drying shrinkage (%): 5.0
Al ₂ O ₃	22.85	Kaolinite	40	Workability: Plastic
Fe ₂ O ₃	2.05	Chlorite-		Dry strength: Good
MnO	0.014	vermiculite	0	Drying defects: None
MgO	0.82	Feldspar	2	pH: 3.7
CaO	0.11	Montmo-		
Na ₂ O	0.22	rillonite	0	
K ₂ O	3.37	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	5.0	21.3	35.5	1.67
982						
1900	Cream	3	7.5	17.7	31.1	1.76
1038						
2000	Tan	6	10.0	13.2	25.0	1.90
1093						
2100	Buff	7	12.5	3.1	7.0	2.30
1149						
2200	Gray	8	15.0	0.8	1.8	2.29
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: A stoneware-type clay of fair quality.

Potential uses: Grade SW building brick; Type FBX facing brick; stoneware; facing tile.

FAYETTE COUNTY South Union Twp. Brownfield quad.Sample number **39-C-2D**

Location: Pennsylvania Department of Transportation core hole C702 at LR 1058, Section 4, Station 505 + 54, offset 25 feet (7.6 m) left, located several hundred feet southeast of the village of Meadowbrook.

Latitude: 39°52'17"N**Longitude:** 79°42'51"W**Geologic unit:** Casselman Formation, Conemaugh Group

Description: Interbedded shales and silty shales were penetrated between the depths of 45.5 and 55.5 feet (13.9 and 16.9 m) in the drill hole. They lie stratigraphically above a limestone unit which is probably the Upper Pittsburgh limestone.

Attitude of bedding: N35E, 5W**Weathering intensity:** Negligible

Sampled interval: Entire core between 45.5 and 55.5 feet (13.9 and 16.9 m) in depth

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	32.10	Quartz	12	Water of plasticity (%): 16.0
TiO ₂	0.63	Mica	58	Drying shrinkage (%): 2.5
Al ₂ O ₃	12.70	Kaolinite	17	Workability: Short
Fe ₂ O ₃	10.16	Chlorite-		Dry strength: Poor
MnO	0.144	vermiculite	2	Drying defects: None
MgO	1.61	Feldspar	1	pH: 7.8
CaO	12.82	Montmo-		
Na ₂ O	0.13	rillonite	3	
K ₂ O	1.74	Calcite	6	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	Poor	--	--	--	--
982		bond				
1900	Beige	Poor	2.5	32.6	48.4	1.48
1038		bond				
2000	Beige	Poor	2.5	31.1	46.6	1.50
1093		bond				
2100	Light brown	Poor	5.0	28.8	44.4	1.54
1149		bond				
2200	Dark brown	5	7.5	19.3	34.3	1.78
1204						
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: Poor ceramic bond. Abrupt vitrification. Poor colors.

Potential uses: Not suitable for use in vitreous clay products.

FAYETTE COUNTY South Union Twp. Brownfield quad.

Sample number **39-C-2E**

Location: Pennsylvania Department of Transportation core hole C702 at LR 1058, Section 4, Station 505 + 54, offset 25 feet (7.6 m) left, located several hundred feet southeast of the village of Meadowbrook.

Latitude: 39°52'17"N

Longitude: 79°42'51"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Dark-greenish-gray to medium-gray interbedded shales and silty shales were penetrated between the depths of 65 and 72 feet (20 and 22 m). They lie stratigraphically above a limestone unit which is probably part of the Upper Pittsburgh limestone. Shales and silty shales are calcareous in part.

Attitude of bedding: N35E, 5W

Weathering intensity: Negligible

Sampled interval: Entire core from depths of 65 to 72 feet (20 to 22 m) in hole

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	61.30	Quartz	29	Water of plasticity (%): 17.6
TiO ₂	1.00	Mica	48	Drying shrinkage (%): 2.5
Al ₂ O ₃	19.80	Kaolinite	15	Workability: Short
Fe ₂ O ₃	4.60	Chlorite-		Dry strength: Poor
MnO	0.060	vermiculite	5	Drying defects: None
MgO	1.58	Feldspar	2	pH: 9.8
CaO	1.27	Montmo-		
Na ₂ O	0.25	rillonite	0	
K ₂ O	2.92	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	16.4	30.1	1.83
982						
1900	Tan	3	2.5	14.2	27.4	1.93
1038						
2000	Orange tan	4	5.0	11.8	23.4	1.99
1093						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2100	Light brown	5	7.5	8.8	18.2	2.08
1149						
2200	Gray brown	7	7.5	4.5	9.6	2.14
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor colors.

Potential uses: Grade SW building brick; Type FBA facing brick.

FAYETTE COUNTY South Union Twp. Brownfield quad.

Sample number 39-C-2F

Location: Pennsylvania Department of Transportation core hole C702 at LR 1058, Section 4, Station 505 + 54, offset 25 feet (7.6 m) left, located several hundred feet southeast of the village of Meadowbrook.

Latitude: 39°52'17"N

Longitude: 79°42'51"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Medium-light-gray to medium-gray interbedded claystones and shales were penetrated between the depths of 80 and 90 feet (24 and 27 m) in the core hole. They occur stratigraphically about 36 feet (11 m) below the base of the Pittsburgh coal.

Attitude of bedding: N35E, 5W**Weathering intensity:** Negligible**Sampled interval:** Entire core between 80 and 90 feet (24 and 27 m)**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	57.20	Quartz	22	Water of plasticity (%): 17.8
TiO ₂	1.00	Mica	52	Drying shrinkage (%): 2.5
Al ₂ O ₃	20.20	Kaolinite	20	Workability: Plastic
Fe ₂ O ₃	8.60	Chlorite-		Dry strength: Fair
MnO	0.071	vermiculite	2	Drying defects: None
MgO	1.40	Feldspar	2	pH: 8.2

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	1.35	Montmo-	
Na ₂ O	0.20	rillonite	0
K ₂ O	2.45	Calcite	1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	3	5.0	15.4	29.3	1.90
982						
1900	Tan	3	5.0	13.7	26.8	1.96
1038						
2000	Light brown	5	7.5	11.4	20.9	1.84
1093						
2100	Light brown	6.5	10.0	6.5	14.5	2.22
1149						
2200	Gray brown	6.5	10.0	1.9	4.5	2.33
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Good color at 1900°F. Might be glazed.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

FAYETTE COUNTY South Union Twp. Brownfield quad.

Sample number 39-C-2G

Location: Pennsylvania Department of Transportation core hole C702 at LR 1058, Section 4, Station 505 + 54, offset 25 feet (7.6 m) left, located several hundred feet southeast of the village of Meadowbrook.

Latitude: 39°52'17"N

Longitude: 79°42'51"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Medium-gray noncalcareous shales occur between 90 and 95 feet (27 and 29 m) in the drill hole. They are stratigraphically about 46 to 51 feet (14 to 16 m) below the Pittsburgh coal. Core hole bottomed at 95 feet (29 m).

Attitude of bedding: N35E, 5W

Weathering intensity: Negligible

Sampled interval: Entire core between depths of 90 and 95 feet (27 and 29 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	58.05	Quartz	27	Water of plasticity (%): 17.0	
TiO ₂	1.04	Mica	56	Drying shrinkage (%): 2.5	
Al ₂ O ₃	16.95	Kaolinite	5	Workability: Short	
Fe ₂ O ₃	7.60	Chlorite-		Dry strength: Fair	
MnO	0.120	vermiculite	7	Drying defects: None	
MgO	1.70	Feldspar	2	pH: 8.5	
CaO	1.76	Montmo-			
Na ₂ O	0.19	rillonite	0		
K ₂ O	2.76	Calcite	1		

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Beige	3	5.0	17.2	32.1	1.87
982						
1900	Tan	3	5.0	14.3	28.0	1.96
1038						
2000	Light brown	5	5.0	12.7	25.3	2.00
1093						
2100	Light brown	5	5.0	10.5	21.9	2.08
1149						
2200	Gray brown	8	10.0	3.1	7.0	2.28
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 1900°F.

Potential uses: Grade SW building brick; Type FBS facing brick.

FAYETTE COUNTY Georges Twp. Brownfield quad.

Sample number **39-C-3**

Location: Pennsylvania Department of Transportation core hole D20A at LR 116, Station 820 + 50, 50 feet (15.2 m) right of the center line. Elevation of collar of hole is at 1171.0 feet (356.9 m) and located about 1000 feet (300 m) south of the village of Chadville.

Latitude: 39°51'52"N

Longitude: 79°44'45"W

Geologic unit: Waynesburg Formation, Dunkard Group

Description: Yellowish-gray shale was penetrated between depths of 15 and 22.5 feet (5 and 6.9 m). Stratigraphically below the shale is a sandstone unit. The shale is probably within the lower portion of the Waynesburg Formation.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Entire core between the depths of 15 and 22.5 feet (5 and 6.9 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	67.50	Quartz	41	Water of plasticity (%): 16.5
TiO ₂	0.77	Mica	36	Drying shrinkage (%): 2.5
Al ₂ O ₃	14.20	Kaolinite	7	Workability: Short
Fe ₂ O ₃	4.70	Chlorite-		Dry strength: Poor
MnO	0.067	vermiculite	3	Drying defects: None
MgO	1.08	Feldspar	10	pH: 8.4
CaO	1.72	Montmo-		
Na ₂ O	1.32	rillonite	1	
K ₂ O	2.19	Calcite	1	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	2.5	18.6	32.6	1.75
982						
1900	Light brown	2	2.5	16.8	30.2	1.80
1038						
2000	Light brown	3	5.0	17.3	31.0	1.79
1093						
2100	Red brown	4	7.5	13.4	25.6	1.91
1149						
2200	Dark brown	8	10.0	2.1	4.5	2.15
1204						
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Fair color at 2100°F.

Potential uses: Grade SW building brick; Type FBS facing brick; drain tile.

FAYETTE COUNTY North Union Twp. Brownfield quad.

Sample number **39-C-4**

Location: Exposure along the north side of U.S. Route 40, about 4500 feet (1370 m) southeast of the village of Hopwood.

Latitude: 39°51'58"N

Longitude: 79°41'05"W

Geologic unit: Mauch Chunk Formation

Description: Predominantly red shales and some green shales are exposed for a minimum stratigraphic thickness of 35 feet (11 m) at this location. Some of the shale is silty above and below the sampled interval. The shale breaks into small fragments having hackly fracture. No effervescence was noted when the shale was treated with hydrochloric acid. Sandy beds of the Pottsville Group overlie the shales of the Mauch Chunk Formation in this exposure.

Attitude of bedding: N15E, 18W

Weathering intensity: Slight to moderate

Sampled interval: Channel through 12 stratigraphic feet (4 m) of shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	62.20	Quartz	31	Water of plasticity (%): 20.0	
TiO ₂	1.38	Mica	64	Drying shrinkage (%): 5.0	
Al ₂ O ₃	16.85	Kaolinite	0	Workability: Plastic	
Fe ₂ O ₃	6.43	Chlorite-		Dry strength: Fair	
MnO	0.055	vermiculite	4	Drying defects: None	
MgO	1.71	Feldspar	1	pH: 8.0	
CaO	0.77	Montmo-			
Na ₂ O	0.13	rillonite	0		
K ₂ O	3.47	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	14.2	27.2	1.91
982						
1900	Orange tan	3	5.0	12.1	23.9	1.99
1038						
2000	Light brown	6	10.0	8.4	17.8	2.12
1093						
2100	Red brown	6	12.5	4.6	10.4	2.25
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2100°F.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe.

FAYETTE COUNTY Wharton Twp. Brownfield quad.Sample number **39-C-7**

Location: Exposure along the west side of the medium-duty road leading generally northwest from Elliottsville, and about 10,800 feet (3290 m) by that road from the Visitation Cemetery.

Latitude: 39°46'47"N

Longitude: 79°39'39"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Light-gray to medium-light-gray claystone occurs in this exposure. Bedding is not apparent. The claystone is relatively soft and breaks easily into roughly tabular-shaped fragments having angular edges. Yellow-orange iron staining is present along fractures. No effervescence occurs when treated with dilute hydrochloric acid.

Attitude of bedding: Not obtained

Weathering intensity: Slight to moderate

Sampled interval: Channel through 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	62.70	Quartz	31	Water of plasticity (%):	20.4
TiO ₂	1.14	Mica	41	Drying shrinkage (%):	5.0
Al ₂ O ₃	22.30	Kaolinite	27	Workability:	Plastic
Fe ₂ O ₃	3.24	Chlorite-		Dry strength:	Good
MnO	0.045	vermiculite	0	Drying defects:	None
MgO	0.60	Feldspar	1	pH:	7.6
CaO	0.25	Montmo-			
Na ₂ O	0.17	rillonite	0		
K ₂ O	2.86	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	16.0	29.1	1.82
982						
1900	Tan	3	7.5	14.7	27.6	1.88
1038						
2000	Tan	6	10.0	8.8	18.3	2.08
1093						
2100	Tan	6	12.5	3.4	7.7	2.26
1149						
2200	Light brown	7	12.5	0.7	1.7	2.38
1204						
2300	Gray	8	15.0	1.5	3.3	2.27
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color at 2000°F. Might be glazed.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile.

FAYETTE COUNTY Wharton Twp. Fort Necessity quad.

Sample number **39-D-8**

Location: Exposure along the southwest side of Pa. Route 381, about 3200 feet (980 m) by road south of the village of Elliottsville.

Latitude: 39°45'44"N

Longitude: 79°37'14"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Moderate-olive-brown, thickly laminated to medium-bedded shaly siltstones are exposed for a stratigraphic interval of 8 feet (2.4 m). Beds range in thickness from 1/4 inch (0.6 cm) to about 7 inches (18 m). The shaly siltstone breaks to form splintery or flaggy fragments having angular edges. No effervescence occurs when treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through entire exposure of 8 stratigraphic feet (2.4 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	66.40	Quartz	25	Water of plasticity (%): 17.3	
TiO ₂	1.08	Mica	64	Drying shrinkage (%): 2.5	
Al ₂ O ₃	15.10	Kaolinite	5	Workability: Short	
Fe ₂ O ₃	5.22	Chlorite-		Dry strength: Fair	
MnO	0.096	vermiculite	2	Drying defects: None	
MgO	1.12	Feidspar	1	pH: 5.4	
CaO	0.27	Montmo-			
Na ₂ O	0.13	rillonite	3		
K ₂ O	2.70	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	2.5	16.8	30.5	1.82
982						
1900	Tan	3	5.0	14.4	27.5	1.91
1038						
2000	Orange tan	5	7.5	11.3	22.5	2.00
1093						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2100	Light red	6	7.5	8.3	17.4	2.09
2149						
2200	Dark red	6	7.5	3.9	8.6	2.16
2204						
2300	--	--	Expanded	--	--	--
260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Good color at 2200°F.

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe;
Type H floor brick.

FAYETTE COUNTY Saltlick Twp. Donegal quad.

Sample number 48-C-3

Location: Exposure along the west side of Pa. Route 711, directly west of the
village of Sagamore.

Latitude: 40°01'58"N

Longitude: 79°24'03"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Pale-olive to greenish-gray, very thin bedded and interbedded shaly
siltstones and silty shales are exposed for a stratigraphic interval of
7 feet (2.1 m). The shales and siltstones commonly break to form
platy fragments. Dark-yellow-orange and moderate-brown iron stains
are present along fractures. Materials are noncalcareous.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate, locally severe

Sampled interval: Channel through 7 stratigraphic feet (2.1 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	62.40	Quartz	22	Water of plasticity (%): 19.5
TiO ₂	0.98	Mica	64	Drying shrinkage (%): 5.0
Al ₂ O ₃	17.10	Kaolinite	11	Workability: Plastic
Fe ₂ O ₃	9.50	Chlorite-		Dry strength: Good
MnO	0.255	vermiculite	2	Drying defects: None
MgO	0.96	Feldspar	1	pH: 6.3
CaO	0.21	Montmo-		
Na ₂ O	0.17	rillonite	0	
K ₂ O	3.19	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	5.0	17.3	31.7	1.83
982						
1900	Orange tan	3	5.0	16.2	27.1	1.67
1038						
2000	Light brown	4	7.5	11.9	24.1	2.01
1093						
2100	Red brown	6	10.0	7.9	17.1	2.16
1149						
2200	Red brown	7	10.0	4.5	10.3	2.28
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color at 2200°F.

Potential uses: Grade SW building brick; Type FBS facing brick; Type H floor brick; sewer pipe.

FAYETTE COUNTY Springfield Twp. Donegal quad.

Sample number 48-C-4

Location: Exposure along the southeast side of Pa. Route 711, about 7500 feet (2290 m) northeast of the village of Normalville.

Latitude: 40°00'48"N

Longitude: 79°25'42"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Olive-gray to medium-dark-gray underclay is exposed beneath the Lower Freeport coal. The underclay is 3 feet (0.9 m) thick and contains carbonaceous trash in the upper 2 feet (0.6 m). It breaks into large irregularly shaped or hackly fragments. Brownish iron stains are common along fractures. The Butler(?) sandstone overlies the Lower Freeport coal.

Attitude of bedding: Essentially horizontal; slight dip to south-southeast

Weathering intensity: Slight to moderate

Sampled interval: Channel through 3 feet (1 m) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	50.20	Quartz	18	Water of plasticity (%): 20.4
TiO ₂	1.02	Mica	39	Drying shrinkage (%): 5.0
Al ₂ O ₃	21.35	Kaolinite	24	Workability: Plastic
Fe ₂ O ₃	4.40	Chlorite-		Dry strength: Good
MnO	0.015	vermiculite	0	Drying defects: None
MgO	0.58	Feldspar	1	pH: 3.8
CaO	0.14	Montmo-		
Na ₂ O	0.15	rillonite	15	
K ₂ O	2.30	Calcite	0	
		Goethite	3	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	17.4	31.2	1.79
982						
1900	Tan	3	5.0	15.5	28.9	1.87
1038						
2000	Tan	5	10.0	9.0	18.8	2.09
1093						
2100	Orange tan	5	12.5	2.8	6.6	2.31
1149						
2200	Light brown	7	15.0	0.7	1.7	2.40
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Good color at 2000°F. Might be glazed.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile.

FAYETTE COUNTY Stewart Twp. Mill Run quad.

Sample number 49-A-4A

Location: Exposure along the north side of Pa. Route 381, about 7500 feet (2290 m) by that route north from the river crossing at Ohiopyle.

Latitude: 39°52'42"N

Longitude: 79°28'20"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Dark-gray to grayish-black, very fissile shale occurs above 38 inches (97 cm) of coal, the upper half of the coal being bony. The coal is probably the Brookville-Clarion seam. Siderite nodules occur occasionally in the shale interval. Yellow and brown iron stains are present along fractures in the shale.

Attitude of bedding: N10E, 5W

Weathering intensity: Slight to moderate

Sampled interval: Channel through 10 stratigraphic feet (3 m) of shale

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	54.30	Quartz	13	Water of plasticity (%): 22.4
TiO ₂	0.97	Mica	63	Drying shrinkage (%): 5.0
Al ₂ O ₃	22.20	Kaolinite	19	Workability: Short
Fe ₂ O ₃	6.58	Chlorite-		Dry strength: Fair
MnO	0.033	vermiculite	1	Drying defects: None
MgO	1.25	Feldspar	4	pH: 4.2
CaO	0.18	Montmo-		
Na ₂ O	0.20	rillonite	0	
K ₂ O	3.63	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	20.7	35.2	1.70
982						
1900	Tan	4	5.0	17.1	30.9	1.80
1038						
2000	Dark tan	6	7.5	11.8	23.3	1.97
1093						
2100	Light brown	6	12.5	4.3	9.5	2.24
1149						
2200	Dark brown	7	12.5	0.7	1.6	2.21
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2000°F.

Potential uses: Grade SW building brick; Type FBS facing brick.

FAYETTE COUNTY Stewart Twp. Mill Run quad.

Sample number 49-A-4B

Location: Exposure along the north side of Pa. Route 381, about 7500 feet (2290 m) by that road north from the river crossing at Ohiopyle.

Latitude: 39°52'42"N

Longitude: 79°28'20"W

Geologic unit: Pottsville Group

Description: The upper portion of the underclay to the Brookville coal is exposed for a stratigraphic interval of 2 feet (0.6 m). The underclay is medium dark gray in color and shows brown and yellow iron stains along the fractures. It is noncalcareous.

Attitude of bedding: N10E, 5W

Weathering intensity: Slight to moderate

Sampled interval: Channel through 2 feet (0.6 m) of underclay

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	53.70	Quartz	13	Water of plasticity (%): 18.0
TiO ₂	1.19	Mica	68	Drying shrinkage (%): 5.0
Al ₂ O ₃	24.70	Kaolinite	15	Workability: Short
Fe ₂ O ₃	5.74	Chlorite-		Dry strength: Fair
MnO	0.028	vermiculite	2	Drying defects: None
MgO	1.04	Feldspar	1	pH: 4.6
CaO	0.64	Montmo-		
Na ₂ O	0.19	rillonite	0	
K ₂ O	3.62	Calcite	1	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	17.0	31.0	1.82
982						
1900	Tan	3	5.0	13.7	26.6	1.94
1038						
2000	Tan	6	5.0	10.7	21.6	2.03
1093						
2100	Light brown	6	10.0	6.6	14.3	2.16
1149						
2200	Medium brown	7	10.0	2.6	5.6	2.13
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2000°F.

Potential uses: Grade SW building brick; Type FBS facing brick.

FAYETTE COUNTY Stewart Twp. Ohiopyle quad.Sample number **49-C-3A**

Location: Pennsylvania Department of Transportation core boring #2 at LR 366, Station 39 + 90, 73 feet (22 m) left. Elevation of collar is 1311.1 feet (399.6 m) and located approximately 1500 feet (460 m) north of Ohiopyle.

Latitude: 39°52'22"N**Longitude:** 79°29'34"W**Geologic unit:** Kittanning Formation, Allegheny Group

Description: Medium-gray shales and silty shales were penetrated between the depths of 15 and 24 feet (5 and 7 m) in the hole. Stratigraphically they occur directly above a coal -- probably the Lower Kittanning coal -- which measures 3 feet (0.9 m). The shale is noncalcareous.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Entire core between 15 and 24 feet (5 and 7 m) of depth**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	>70.00	Quartz	42	Water of plasticity (%): 20.5
TiO ₂	1.05	Mica	43	Drying shrinkage (%): 5.0
Al ₂ O ₃	15.70	Kaolinite	12	Workability: Plastic
Fe ₂ O ₃	2.75	Chlorite-		Dry strength: Good
MnO	0.026	vermiculite	2	Drying defects: None
MgO	0.97	Feldspar	1	pH: 8.3
CaO	0.19	Montmo-		
Na ₂ O	0.13	rillonite	0	
K ₂ O	2.66	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	18.7	31.8	1.70
982						
1900	Tan	3	5.0	17.9	31.5	1.75
1038						
2000	Orange tan	4	5.0	16.1	29.3	1.82
1093						
2100	Red tan	4	5.0	11.0	21.8	1.99
1149						
2200	Light brown	7	10.0	7.1	14.9	2.11
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: Fair color at 2200°F.

Potential uses: Grade SW building brick; Type FBA facing brick; structural tile (facing).

FAYETTE COUNTY Stewart Twp. Ohiopyle quad.

Sample number **49-C-3B**

Location: Pennsylvania Department of Transportation core boring #2 at LR 366, Station 39 + 90, 73 feet (22 m) left. Elevation of collar is 1311.1 feet (399.6 m) and located approximately 1500 feet (460 m) north of Ohiopyle.

Latitude: 39°52'22"N

Longitude: 79°29'34"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Gray underclay to a 3-foot- (0.9-m-) thick coal -- probably the Lower Kittanning coal -- was penetrated between depths of 27 and 29 feet (8 and 9 m). The underclay is noncalcareous.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Entire core between 27 and 29 feet (8 and 9 m)

Chemical analysis:

	%
SiO ₂	46.20
TiO ₂	1.31
Al ₂ O ₃	28.90
Fe ₂ O ₃	4.85
MnO	0.026
MgO	0.80
CaO	0.59
Na ₂ O	0.21
K ₂ O	2.83

Mineralogy (X-ray):

	%
Quartz	7
Mica	52
Kaolinite	32
Chlorite-vermiculite	0
Feldspar	1
Montmorillonite	5
Calcite	0
Siderite present	
Pyrite	3?
Gypsum present	
Jarosite present	

Raw properties:

Water of plasticity (%)	19.9
Drying shrinkage (%)	5.0
Workability:	Plastic
Dry strength:	Fair
Drying defects:	None
pH:	4.9

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Orange tan	3	5.0	18.7	32.9	1.76
982						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1900	Orange tan	3	7.5	14.9	28.2	1.89
1038						
2000	Light brown	6	10.0	10.4	21.2	2.05
1093						
2100	Olive	6	15.0	4.4	10.2	2.29
1149						
2200	Olive	8	15.0	3.8	8.3	2.22
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor colors.

Potential uses: Grade SW building brick.

FAYETTE COUNTY Stewart Twp. Ohiopyle quad.

Sample number 49-C-3C

Location: Pennsylvania Department of Transportation core boring #2 at LR 366, Station 39 + 90, 73 feet (22 m) left. Elevation of collar is 1311.1 feet (399.6 m) and located approximately 1500 feet (460 m) north of Ohiopyle.

Latitude: 39°52'22"N

Longitude: 79°29'34"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Medium-light-gray to medium-gray, noncalcareous clay was penetrated between the depths of 32.5 and 40.2 feet (9.9 and 12.3 m) in the hole.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Entire core between depths of 32.5 and 40.2 feet (9.9 and 12.3 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

%		%	
SiO ₂	63.20	Quartz	24
TiO ₂	1.43	Mica	38
Al ₂ O ₃	24.85	Kaolinite	38
Fe ₂ O ₃	1.89	Chlorite-	
MnO	0.021	vermiculite	0
MgO	0.66	Feldspar	2

Water of plasticity (%): 16.0

Drying shrinkage (%): 5.0

Workability: Short

Dry strength: Good

Drying defects: None

pH: 5.8

Chemical analysis: Mineralogy (X-ray):

	%		%
CaO	0.24	Montmo-	
Na ₂ O	0.20	rillonite	0
K ₂ O	3.21	Calcite	0

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Cream	3	5.0	15.8	28.6	1.81
982						
1900	Cream	3	5.0	14.2	26.5	1.87
1038						
2000	Tan	6	10.0	12.9	25.3	1.95
1093						
2100	Tan	6	10.0	9.4	19.4	2.07
1149						
2200	Buff	8	10.0	5.9	12.9	2.19
1204						
2300	Gray	8	10.0	3.3	7.2	2.22
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: A stoneware-type clay of good quality.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; stoneware.

FAYETTE COUNTY Stewart Twp. Ohiopyle quad.

Sample number **49-C-3D**

Location: Pennsylvania Department of Transportation core boring #2 at LR 366, Station 39 + 90, 73 feet (22 m) left. Elevation of collar is 1311.1 feet (399.6 m) and located approximately 1500 feet (460 m) north of Ohiopyle.

Latitude: 39°52'22"N

Longitude: 79°29'34"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Olive-gray to medium-gray shale was penetrated between the depths of 53 and 59 feet (16 and 18 m) in the hole. The shale is stratigraphically above a 4-foot (1.2-m) coal -- probably the Brookville-Clarion coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: None

Sampled interval: Entire core between depths of 53 and 59 feet (16 and 18 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	56.70	Quartz	21	Water of plasticity (%): 18.0	
TiO ₂	0.88	Mica	50	Drying shrinkage (%): 5.0	
Al ₂ O ₃	20.50	Kaolinite	26	Workability: Short	
Fe ₂ O ₃	10.67	Chlorite-		Dry strength: Fair	
MnO	0.134	vermiculite	1	Drying defects: None	
MgO	1.08	Feldspar	2	pH: 6.4	
CaO	0.79	Montmo-			
Na ₂ O	0.17	rillonite	0		
K ₂ O	3.23	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	3	5.0	17.1	31.8	1.86
982						
1900	Beige	3	5.0	14.6	28.8	1.96
1038						
2000	Tan	6	7.5	12.4	25.7	2.07
1093						
2100	Light brown	6	7.5	7.8	17.6	2.26
1149						
2200	Dark brown	8	10.0	3.8	9.1	2.38
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Poor colors.

Potential uses: Grade SW building brick.

FAYETTE COUNTY Stewart Twp. Ohiopyle quad.

Sample number 49-C-3E

Location: Pennsylvania Department of Transportation core boring #2 at LR 366, Station 39 + 90, 73 feet (22 m) left. Elevation of collar is 1311.1 feet (399.6 m) and located approximately 1500 feet (460 m) north of Ohiopyle.

Latitude: 39°52'22"N

Longitude: 79°29'34"W

Geologic unit: Pottsville Group

Description: Medium-gray noncalcareous underclay to the Brookville-Clarion(?) coal was penetrated between the depths of 63 and 64 feet (19 and 20 m).

Attitude of bedding: Essentially horizontal

Weathering intensity: None

Sampled interval: Entire core between depths of 63 and 64 feet (19 and 20 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	51.20	Quartz	22	Water of plasticity (%): 16.0
TiO ₂	1.60	Mica	18	Drying shrinkage (%): 5.0
Al ₂ O ₃	33.50	Kaolinite	49	Workability: Short
Fe ₂ O ₃	2.10	Chlorite-		Dry strength: Poor
MnO	0.014	vermiculite	2	Drying defects: None
MgO	0.70	Feldspar	2	pH: 5.6
CaO	0.27	Montmo-		
Na ₂ O	0.15	rillonite	6	
K ₂ O	1.42	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	7.5	18.2	32.0	1.76
982						
1900	Cream	4	7.5	18.0	31.6	1.75
1038						
2000	Cream	6	10.0	16.9	30.6	1.81
1093						
2100	Ivory	6	10.0	12.8	25.0	1.96
1149						
2200	Ivory	7	10.0	12.1	24.2	2.00
1204						
2300	Ivory	7	10.0	10.9	21.9	2.02
1260						

Pyrometric cone equivalent: 31 (1683°C)
(3061°F)

Bloating test: Negative

Potential uses: Grade SW building brick; Type FBA facing brick; facing tile; medium-duty refractories.

FAYETTE COUNTY Henry Clay Twp. Friendsville quad.Sample number **140-A-1A**

Location: Exposure along the north side of U.S. Route 40, about 0.7 mile (1.1 km) southeast of its intersection with Pa. Route 281.

Latitude: 39°44'57"N**Longitude:** 79°25'49"W**Geologic unit:** Glenshaw Formation, Conemaugh Group

Description: Dark-gray to grayish-black shale occurs for a distance of 14 feet (4 m) above a coal seam which measures 9 inches (23 cm) in thickness. The shale breaks to form splintery or platy fragments. A moderate amount of brown iron staining occurs along bedding planes in the shale.

Attitude of bedding: Essentially horizontal; dip may locally be a few degrees to the west

Weathering intensity: Slight to moderate**Sampled interval:** Channel through 14 feet (4 m) of shale**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	49.90	Quartz	31	Water of plasticity (%): 19.7
TiO ₂	0.81	Mica	55	Drying shrinkage (%): 5.0
Al ₂ O ₃	15.30	Kaolinite	0	Workability: Short
Fe ₂ O ₃	5.11	Chlorite-		Dry strength: Poor
MnO	0.083	vermiculite	8	Drying defects: None
MgO	1.25	Feldspar	6	pH: 6.1
CaO	0.54	Montmo-		
Na ₂ O	0.42	rillonite	0	
K ₂ O	2.60	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Beige	3	5.0	19.1	33.8	1.77
982						
1900	Beige	3	7.5	14.3	27.4	1.92
1038						
2000	Light brown	6	10.0	9.6	20.0	2.09
1093						
2100	Dark brown	6	10.0	6.3	13.4	2.15
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Positive

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	1.72	107.1	10.0	No expansion.
982				
1900	1.57	98.2	15.8	No expansion.
1038				
2000	1.17	72.9	18.5	Laminar expansion.
1093				
2100	1.02	63.6	20.0	Some fusion, sticky.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for lightweight aggregate (short range). Poor colors in slow-firing tests.

Potential uses: Grade SW building brick.

FAYETTE COUNTY Henry Clay Twp. Friendsville quad.

Sample number 140-A-1B

Location: Exposure along the north side of U.S. Route 40, about 0.7 mile (1.1 km) southeast of its intersection with Pa. Route 281.

Latitude: 39°44'57"N

Longitude: 79°25'49"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-gray underclay to a 9-inch- (23-cm-) thick coal which may be one of the seams in the Bakerstown group. The underclay breaks to form hackly to flaggy fragments that have dark-yellow-orange and moderate-brown iron stains evident along fractures.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate to slight

Sampled interval: Channel through entire 4 feet (1.2 m) of underclay

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	56.00	Quartz	25	Water of plasticity (%): 22.1
TiO ₂	1.05	Mica	0	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.55	Kaolinite	11	Workability: Plastic
Fe ₂ O ₃	8.30	Chlorite-		Dry strength: Good
MnO	0.035	vermiculite	0	Drying defects: None
MgO	0.91	Feldspar	1	pH: 3.8

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	0.18	Montmo-	
Na ₂ O	0.10	rillonite	63
K ₂ O	2.23	Calcite	0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Orange tan	3	7.5	19.1	34.7	1.82
982						
1900	Orange tan	3	7.5	12.7	24.6	1.94
1038						
2000	Orange tan	6	12.5	10.4	21.7	2.08
1093						
2100	Light brown	7	15.0	3.7	8.5	2.31
1149						
2200	Red brown	8	15.0	1.5	3.6	2.36
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Good color at 2200°F.

Potential uses: Grade SW building brick; Type M floor brick.

GREENE COUNTY Richhill Twp. Wind Ridge quad.

Sample number **9-A-7**

Location: Exposure along the southeast side of Pa. Route 21 where it passes between North Fork and South Fork (streams) at Ryerson Station.

Latitude: 39°53'28"N

Longitude: 80°28'35"W

Geologic unit: Washington Formation, Dunkard Group

Description: Pale-olive calcareous silty claystone is exposed for a stratigraphic interval of 8 feet (2.4 m). Calcareous nodules and calcite veinlets are present occasionally in the interval, weathering to a brown color. Micaceous flakes in minor amounts are also present.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 8 stratigraphic feet (2.4 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	58.10	Quartz	18	Water of plasticity (%): 17.0	
TiO ₂	0.97	Mica	60	Drying shrinkage (%): 5.0	
Al ₂ O ₃	19.40	Kaolinite	5	Workability: Short	
Fe ₂ O ₃	5.53	Chlorite-		Dry strength: Poor	
MnO	0.047	vermiculite	5	Drying defects: None	
MgO	1.54	Feldspar	5	pH: 8.6	
CaO	2.09	Montmo-			
Na ₂ O	0.62	rillonite	4		
K ₂ O	3.44	Calcite	3		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	16.7	30.6	1.84
982						
1900	Orange tan	3	5.0	14.5	27.7	1.92
1038						
2000	Light brown	3	5.0	11.4	23.2	2.02
1093						
2100	Red brown	5	7.5	7.5	16.0	2.13
1149						
2200	Dark brown	7	10.0	1.2	2.8	2.27
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Effervesces with HCl treatment. Fair color at 2100°F.

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates.

GREENE COUNTY Gray Twp. Wind Ridge quad.

Sample number 9-A-9

Location: Exposure along the north side of Pa. Route 21, about 4000 feet (1220 m) west of the village of Graysville.

Latitude: 39°55'43"N

Longitude: 80°24'02"W

Geologic unit: Greene Formation, Dunkard Group

Description: Light-olive-gray to grayish-olive and yellow-gray shales are exposed for an interval of 51 inches (130 cm) beneath thin-bedded to massive sandstones. A 7-inch (18-cm) dark limestone is beneath the shale. The shale breaks down into platy fragments having angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel through 51 inches (130 cm) of shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	57.20	Quartz	16	Water of plasticity (%): 22.3
TiO ₂	1.02	Mica	68	Drying shrinkage (%): 5.0
Al ₂ O ₃	20.30	Kaolinite	9	Workability: Plastic
Fe ₂ O ₃	7.47	Chlorite-		Dry strength: Good
MnO	0.044	vermiculite	5	Drying defects: None
MgO	1.63	Feldspar	2	pH: 7.4
CaO	0.62	Montmo-		
Na ₂ O	0.52	rillonite	0	
K ₂ O	3.56	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	3	5.0	14.6	27.2	1.86
982	(5YR6/8)					
1900	Brownish orange	4	10.0	8.5	17.9	2.09
1038	(2.5YR5/8)					
2000	Strong brown	7	12.5	2.3	5.3	2.34
1093	(2.5YR4/6)					
2100	Strong brown	7	12.5	1.9	4.4	2.35
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F).

Potential uses: Grade SW building brick.

*Munsell designation

GREENE COUNTY Center Twp. Rogersville quad.

Sample number 9-B-8

Location: Exposure along the north side of Pa. Route 21, about 8000 feet (2440 m) southeast of the village of Rutan.

Latitude: 39°53'04"N

Longitude: 80°19'00"W

Geologic unit: Greene Formation, Dunkard Group

Description: Grayish-olive shales, interbedded with a few thin siltstone beds which measure from 1-1/4 to 1-1/2 inches (3.2 to 3.8 cm) in thickness, occur beneath a massive sandstone. The shale breaks down into platy fragments; the siltstone forms slabby fragments. Some effervescence noted when treated with dilute hydrochloric acid.

Attitude of bedding: N55W, 4NE

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 5 feet (1.5 m) of shale-siltstone interval

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	55.60	Quartz	14	Water of plasticity (%): 21.7	
TiO ₂	1.04	Mica	74	Drying shrinkage (%): 5.0	
Al ₂ O ₃	19.65	Kaolinite	0	Workability: Plastic	
Fe ₂ O ₃	7.04	Chlorite-		Dry strength: Good	
MnO	0.039	vermiculite	5	Drying defects: None	
MgO	2.13	Feldspar	6	pH: 8.3	
CaO	2.11	Montmo-			
Na ₂ O	0.52	rillonite	0		
K ₂ O	3.85	Calcite	1		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	3	7.5	14.9	27.9	1.87
982	(5YR6/8)					
1900	Brownish orange	3	10.0	10.0	20.1	2.02
1038	(2.5Y 35/8)					
2000	Strong brown	6	12.5	3.6	8.2	2.27
1093	(2.5YR4/6)					
2100	Strong brown	6	12.5	3.1	7.1	2.30
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F).

Potential uses: Not suitable for use in vitreous clay products.

* Munsell designation

GREENE COUNTY Gray Twp. Rogersville quad.Sample number **9-B-10**

Location: Exposure along the north side of the medium-duty road leading north-northeast out of the village of Graysville, about 7000 feet (2130 m) by road from Graysville.

Latitude: 39°56'34"N

Longitude: 80°22'08"W

Geologic unit: Greene Formation, Dunkard Group

Description: Greenish-gray to grayish-red claystones, interbedded with a few siltstones, occur in the lower portion of the exposure under an 8-inch (20-cm) limestone. Above the limestone is 58 inches (147 cm) of shale, followed by sandstone beds at the top of the exposure. The claystone sequence effervesces when treated with dilute hydrochloric acid. The claystones break down into hackly, chippy, or slabby fragments having angular edges.

Attitude of bedding: N-S, 4E**Weathering intensity:** Slight to moderate**Sampled interval:** Channel sample through 10 feet (3 m) of claystone**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	54.60	Quartz	18	Water of plasticity (%): 20.9
TiO ₂	0.87	Mica	67	Drying shrinkage (%): 2.5
Al ₂ O ₃	19.85	Kaolinite	7	Workability: Plastic
Fe ₂ O ₃	7.36	Chlorite-		Dry strength: Good
MnO	0.057	vermiculite	3	Drying defects: None
MgO	1.73	Feldspar	4	pH: 8.3
CaO	2.46	Montmo-		
Na ₂ O	0.39	rillonite	0	
K ₂ O	3.66	Calcite	1	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	3	7.5	14.2	27.0	1.90
982	(5YR6/8)					
1900	Brownish orange	3	10.0	10.3	20.8	2.02
1038	(2.5YR5/8)					
2000	Strong brown	6	10.0	4.3	9.5	2.22
1093	(2.5YR4/6)					
2100	Strong brown	6	12.5	4.1	9.2	2.23
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative

*Munsell designation

Remarks: Abrupt vitrification (2100-2200°F).

Potential uses: Not suitable for use in vitreous clay products.

GREENE COUNTY Morris Twp. Rogersville quad.

Sample number **9-B-11**

Location: Exposure along a medium-duty road trending roughly north-south, about 1000 feet (300 m) south of Beulah Church.

Latitude: 39°59'00"N

Longitude: 80°20'45"W

Geologic unit: Greene Formation, Dunkard Group

Description: Dusky-yellow to light-olive-brown claystones and silty claystones are exposed along the roadway. The claystones break down into hackly, chippy, and slabby fragments having angular edges. A minor amount of manganese staining occurs along fractures.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate to severe

Sampled interval: Channel through 12 stratigraphic feet (4 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	55.70	Quartz	24	Water of plasticity (%):	22.8
TiO ₂	0.90	Mica	59	Drying shrinkage (%):	5.0
Al ₂ O ₃	20.15	Kaolinite	6	Workability:	Plastic
Fe ₂ O ₃	7.98	Chlorite-		Dry strength:	Good
MnO	0.045	vermiculite	2	Drying defects:	None
MgO	1.80	Feldspar	3	pH:	7.2
CaO	0.48	Montmo-			
Na ₂ O	0.36	rillonite	6		
K ₂ O	3.85	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	3	5.0	13.9	26.4	1.90
982	(5YR6/8)					
1900	Brownish orange	4	10.0	8.8	18.1	2.07
1038	(2.5YR5/8)					
2000	Strong brown	7	15.0	1.8	4.3	2.36
1093	(2.5YR4/6)					
2100	Strong brown	7	15.0	1.4	3.2	2.38
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

*Munsell designation

Remarks: Abrupt vitrification (1900-2000°F). Soft. No effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

GREENE COUNTY Springhill Twp. New Freeport quad.

Sample number **9-C-4**

Location: Exposure along the north side of a medium-duty road connecting New Freeport and Deep Valley; the exposure is located about 6000 feet (1830 m) west of New Freeport.

Latitude: 39°45'41"N

Longitude: 80°26'44"W

Geologic unit: Greene Formation, Dunkard Group

Description: Grayish-red, medium-light-gray, and grayish-olive shales change stratigraphically downward into pale-red and dark-gray shales in this exposure. The upper 2 to 3 feet (0.6 to 0.9 m) of section is slightly calcareous. The shale breaks down into platy fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 12 stratigraphic feet (4 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	55.80	Quartz	20	Water of plasticity (%): 18.0
TiO ₂	0.87	Mica	66	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.75	Kaolinite	9	Workability: Plastic
Fe ₂ O ₃	6.93	Chlorite-		Dry strength: Good
MnO	0.09	vermiculite	2	Drying defects: None
MgO	1.54	Feldspar	2	pH: 8.5
CaO	2.29	Montmo-		
Na ₂ O	0.35	rillonite	0	
K ₂ O	3.50	Calcite	1	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	4	7.5	12.3	24.4	1.97
982						
1900	Orange tan	5	10.0	8.2	17.3	2.12
1038						
2000	Light brown	6	10.0	2.6	6.2	2.32
1093						
2100	Medium brown	6	10.0	1.4	3.2	2.34
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Potential uses: Grade SW building brick; Type M floor brick.

Sample number 9-C-5

Longitude: 80°22'33"W

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	59.30	Quartz	26	Water of plasticity (%): 17.0	
TiO ₂	0.91	Mica	62	Drying shrinkage (%): 5.0	
Al ₂ O ₃	19.20	Kaolinite	4	Workability: Short	
Fe ₂ O ₃	6.58	Chlorite-		Dry strength: Poor	
MnO	0.068	vermiculite	1	Drying defects: None	
MgO	1.66	Feldspar	4	pH: 8.5	
CaO	1.48	Montmo-			
Na ₂ O	0.64	rillonite	3		
K ₂ O	3.25	Calcite	0		

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800 982	Tan	4	5.0	15.8	29.5	1.87
1900 1038	Orange tan	4	5.0	11.5	23.3	2.03
2000 1093	Light brown	5	7.5	8.7	18.3	2.11
2100 1149	Red brown	5	10.0	4.8	10.6	2.21

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2200	Red brown	7	10.0	2.0	4.4	2.19
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Effervesces when treated with HCl.**Potential uses:** Grade SW building brick; Type FBA facing brick; sewer pipe; Type H floor brick.**GREENE COUNTY Aleppo Twp. New Freedom quad.**Sample number **9-C-6****Location:** Exposure along the east side of the medium-duty road leading north out of the village of Aleppo, about 500 feet (150 m) north of the road intersection at the north side of Aleppo.**Latitude:** 39°49'30"N**Longitude:** 80°26'46"W**Geologic unit:** Greene Formation, Dunkard Group**Description:** Grayish-olive to olive-gray, slightly silty shales grade downward stratigraphically to grayish-red shales. Locally, the shales are calcareous. They break down to form hackly or platy fragments; iron staining is evident along fractures.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Channel sample through lower 10 stratigraphic feet (3 m) in the exposure**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	54.00	Quartz	21	Water of plasticity (%): 18.4
TiO ₂	0.97	Mica	64	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.40	Kaolinite	4	Workability: Plastic
Fe ₂ O ₃	7.48	Chlorite-		Dry strength: Fair
MnO	0.102	vermiculite	6	Drying defects: None
MgO	1.90	Feldspar	5	pH: 8.5
CaO	0.94	Montmo-		
Na ₂ O	0.52	rillonite	0	
K ₂ O	3.48	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	2	5.0	15.3	28.6	1.87
982						
1900	Tan	4	5.0	12.5	24.7	1.98
1038						
2000	Orange tan	5	10.0	7.7	16.7	2.15
1093						
2100	Red brown	5	10.0	3.2	7.5	2.33
1149						
2200	Dark brown	7	10.0	0.6	1.5	2.36
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Fair color at 2100°F. May be limy.

Potential uses: Grade SW building brick; sewer pipe; Type H floor brick.

GREENE COUNTY Center Twp. Holbrook quad.

Sample number **9-D-3**

Location: Exposure along the west side of Pa. Route 18, about 1500 feet (460 m) south of the village of Holbrook.

Latitude: 39°51'06"N

Longitude: 80°18'58"W

Geologic unit: Washington Formation, Dunkard Group

Description: Dusky-yellow to yellowish-gray shales which change to medium-gray shales about 6 feet (1.8 m) down from the top of the interval sampled. The thicknesses of beds range from very thin to thin. The shales commonly break into platy to flaggy fragments having angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 8 stratigraphic feet (2.4 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	56.20	Quartz	21	Water of plasticity (%): 19.9
TiO ₂	1.01	Mica	62	Drying shrinkage (%): 2.5
Al ₂ O ₃	19.85	Kaolinite	9	Workability: Short
Fe ₂ O ₃	8.13	Chlorite-		Dry strength: Fair
MnO	0.063	vermiculite	2	Drying defects: None
MgO	1.73	Feldspar	6	pH: 4.9
CaO	0.42	Montmo-		
Na ₂ O	0.61	rillonite	0	
K ₂ O	3.42	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	4	2.5	18.4	32.6	1.77
982						
1900	Tan	5	5.0	13.6	26.3	1.93
1038						
2000	Light brown	5	7.5	10.4	21.4	2.06
1093						
2100	Red brown	5	10.0	5.5	12.1	2.20
1149						
2200	Medium brown	7	10.0	1.4	3.2	2.27
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Positive

Remarks: Fair color at 2100°F. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe; Type H floor brick.

GREENE COUNTY Wayne Twp. Holbrook quad.

Sample number **9-D-12**

Location: Exposure along the west side of a light-duty road which parallels Bulldog Run. The exposure is located about 4300 feet (1310 m) southeast of the village of Kuhntown.

Latitude: 39°45'48"N

Longitude: 80°15'42"W

Geologic unit: Greene Formation, Dunkard Group

Description: Moderate-olive-brown claystone grading down into dark-gray shale is exposed along the roadway. The claystone breaks down into hackly, chippy, or slabby fragments which are commonly larger than the platy fragments formed by shale. Most of the claystones effervesce when treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate to slight

Sampled interval: Channel sample through 8 stratigraphic feet (2.4 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	56.10	Quartz	18	Water of plasticity (%): 20.6	
TiO ₂	1.04	Mica	57	Drying shrinkage (%): 7.5	
Al ₂ O ₃	20.50	Kaolinite	16	Workability: Plastic	
Fe ₂ O ₃	7.45	Chlorite-		Dry strength: Good	
MnO	0.049	vermiculite	3	Drying defects: None	
MgO	2.10	Feldspar	6	pH: 8.4	
CaO	0.55	Montmo-			
Na ₂ O	0.58	rillonite	0		
K ₂ O	3.35	Calcite	0		

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color*</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Moderate orange	3	7.5	15.3	28.6	1.86
982	(5YR6/8)					
1900	Brownish orange	3	7.5	12.4	24.3	1.97
1038	(2.5YR5/8)					
2000	Strong brown	6	12.5	5.2	11.6	2.23
1093	(2.5YR4/6)					
2100	Strong brown	6	12.5	4.5	10.1	2.25
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (1900-2000°F).

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

GREENE COUNTY Jackson Twp. Holbrook quad.

Sample number **9-D-13**

Location: Exposure along the west side of the railroad, about 700 feet (210 m) west of the village of Buzz.

Latitude: 39°47'14"N

Longitude: 80°19'29"W

Geologic unit: Greene Formation, Dunkard Group

Description: Dark-greenish-gray to dark-gray shales are exposed beneath a massive 58-inch (147-cm) sandstone unit. The shale commonly breaks down into platy fragments, although some flaggy fragments are present.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample through 9 stratigraphic feet (2.7 m) of shale

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	52.20	Quartz	16	Water of plasticity (%): 20.3
TiO ₂	0.98	Mica	70	Drying shrinkage (%): 5.0
Al ₂ O ₃	20.00	Kaolinite	7	Workability: Plastic
Fe ₂ O ₃	9.21	Chlorite-		Dry strength: Fair
MnO	0.115	vermiculite	5	Drying defects: None
MgO	2.30	Feldspar	2	pH: 8.4
CaO	0.80	Montmo-		
Na ₂ O	0.49	rillonite	0	
K ₂ O	3.70	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Mod. yellowish pink to	3	7.5	14.9	27.9	1.88
982	mod. orange (5YR7/6)					
1900	Moderate orange	3	7.5	11.6	23.1	1.99
1038	(2.5YR6/8)					
2000	Strong brown	7	10.0	4.6	10.5	2.26
1093	(2.5YR4/6)					
2100	Strong brown	7	10.0	3.4	7.7	2.30
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F). Slight effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

GREENE COUNTY Center Twp. Waynesburg quad.

Sample number **19-A-3**

Location: Exposure along the northeast side of Pa. Route 21, about 5500 feet (1680 m) by road south along that route from the village of East View.

Latitude: 39°53'19"N

Longitude: 80°14'02"W

Geologic unit: Washington Formation, Dunkard Group

Description: Grayish-olive shales grade stratigraphically down to medium-gray and medium-dark-gray shales and slightly silty shales. The thicknesses of beds are very thin to thin. The shales break into platy fragments having angular edges. Orange-yellow-red iron stains are locally present. The upper 2 feet (0.6 m) of the sampled interval effervesces when treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Channel sample through 10 stratigraphic feet (3 m)**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	55.90	Quartz	20	Water of plasticity (%): 19.1
TiO ₂	1.06	Mica	69	Drying shrinkage (%): 5.0
Al ₂ O ₃	22.05	Kaolinite	0	Workability: Plastic
Fe ₂ O ₃	7.14	Chlorite-		Dry strength: Fair
MnO	0.076	vermiculite	3	Drying defects: None
MgO	1.68	Feldspar	4	pH: 8.3
CaO	0.86	Montmo-		
Na ₂ O	0.36	rillonite	3	
K ₂ O	3.89	Calcite	1	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Tan	4	5.0	13.5	25.9	1.93
1900 1038	Orange tan	5	5.0	11.0	22.6	2.05
2000 1093	Light brown	6	7.5	3.9	9.1	2.30
2100 1149	Red brown	6	15.0	1.3	3.1	2.39
2200 1204	Medium brown	8	10.0	0.7	1.5	2.32
2300 1260	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND**Bloating test:** Positive**Remarks:** Fair color at 2100°F in slow-firing tests.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	2.15	134.2	6.5	No expansion.
982				
1900	1.35	84.2	9.1	Slight expansion.
1038				
2000	1.33	82.9	12.4	Slight expansion.
1093				
2100	0.89	55.2	8.3	Good pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.**Potential uses:** Grade SW building brick; Type M floor brick; promising raw material for lightweight aggregate.**GREENE COUNTY Washington Twp. Waynesburg quad.**Sample number **19-A-8****Location:** Exposure along the east side of the medium-duty road which parallels Garners Run, about 10,600 feet (3230 m) north of this road's southern termination.**Latitude:** 39°56'55"N**Longitude:** 80°13'53"W**Geologic unit:** Greene Formation, Dunkard Group**Description:** Light-olive-brown to light-olive-gray, very thin bedded silty shales are exposed along the road. Fragments of the silty shale are commonly platy and have angular edges. No effervescence noted when the sampled interval was treated with dilute hydrochloric acid.**Attitude of bedding:** N30W, 3NE**Weathering intensity:** Moderate to slight**Sampled interval:** Channel sample through 7 stratigraphic feet (2.1 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	55.30	Quartz	17	Water of plasticity (%): 21.8
TiO ₂	1.09	Mica	60	Drying shrinkage (%): 5.0
Al ₂ O ₃	21.40	Kaolinite	11	Workability: Plastic
Fe ₂ O ₃	7.83	Chlorite-		Dry strength: Good
MnO	0.07	vermiculite	1	Drying defects: None
MgO	1.73	Feldspar	5	pH: 6.9
CaO	0.56	Montmo-		
Na ₂ O	0.56	rillonite	6	
K ₂ O	3.25	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	3	5.0	15.3	28.4	1.85
982	(5YR6/8)					
1900	Brownish orange	4	10.0	10.3	20.8	2.02
1038	(2.5YR5/8)					
2000	Strong brown	5	12.5	4.5	10.2	2.26
1093	(2.5YR4/6)					
2100	Strong brown	5	12.5	3.3	7.5	2.29
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F).

Potential uses: Grade SW building brick.

*Munsell designation

GREENE COUNTY Washington Twp. Waynesburg quad.

Sample number 19-A-9

Location: Exposure in a small abandoned quarry located northwest of an intersection of two unidentified medium-duty roads. The intersection occurs about 5600 feet (1710 m) by road southeast of the village of Sycamore.

Latitude: 39°55'10"N

Longitude: 80°13'52"W

Geologic unit: Washington Formation, Dunkard Group

Description: Grayish-red, light-olive-brown, and dusky-yellow shales are exposed for a stratigraphic interval of 15 to 20 feet (5 to 6 m) beneath a sandstone bed in the quarry. This interval probably belongs in the upper half of the Washington Formation. The shales break into platy to flaggy fragments having angular edges. Treatment of the shale with dilute hydrochloric acid showed no indication of effervescence.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 7 stratigraphic feet (2.1 m)

Chemical analysis:		Mineralogy (X-ray):	Raw properties:
	%		%
SiO ₂	55.20	Quartz	17
TiO ₂	0.98	Mica	62
Al ₂ O ₃	19.35	Kaolinite	11
Fe ₂ O ₃	7.97	Chlorite-	
MnO	0.05	vermiculite	5
MgO	1.77	Feldspar	5
CaO	0.68	Montmo-	
Na ₂ O	0.55	rillonite	0
K ₂ O	3.72	Calcite	0
			Water of plasticity (%): 21.1
			Drying shrinkage (%): 5.0
			Workability: Plastic
			Dry strength: Good
			Drying defects: None
			pH: 7.6

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	3	7.5	12.7	24.6	1.94
982	(5YR6/8)					
1900	Brownish orange	4	10.0	6.4	13.9	2.18
1038	(2.5YR5/8)					
2000	Strong brown	6	15.0	1.4	3.5	2.42
1093	(2.5YR4/6)					
2100	Moderate reddish	6	15.0	0.4	0.9	2.43
1149	brown (2.5YR4/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (1900-2000°F). High shrinkage.

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

GREENE COUNTY Franklin Twp. Waynesburg quad.Sample number **19-A-10**

Location: Exposure along the north side of Pa. Route 21 in the vicinity of the Greene County Airport, about 4600 feet (1400 m) east of the Interstate Route 79 overpass at Pa. Route 21.

Latitude: 39°53'57"N

Longitude: 80°07'42"W

Geologic unit: Waynesburg Formation, Dunkard Group

Description: Greenish-gray underclay to a 9-inch (23-cm) coal, probably the Waynesburg "A" seam, is exposed along the roadway. Separating the underclay from the coal is a 9-inch (23-cm) layer of carbonaceous clay which was not sampled. The underclay is relatively soft, and breaks into small hackly fragments. Effervescence was not noted when the material was treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Moderate**Sampled interval:** Channel sample through 12 inches (30 cm) of underclay**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	63.30	Quartz	24	Water of plasticity (%): 30.0
TiO ₂	0.97	Mica	54	Drying shrinkage (%): 7.5
Al ₂ O ₃	18.15	Kaolinite	0	Workability: Plastic
Fe ₂ O ₃	5.19	Chlorite-		Dry strength: Good
MnO	0.008	vermiculite	0	Drying defects: None
MgO	1.36	Feldspar	1	pH: 3.5
CaO	0.26	Montmo-		
Na ₂ O	0.17	rillonite	20	
K ₂ O	4.23	Calcite	0	
		Gypsum	1	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	4	7.5	12.2	23.7	1.95
982	(5YR6/8)					
1900	Brownish orange	5	15.0	3.2	7.3	2.29
1038	(2.5YR5/8)					
2000	--	--	Melted	--	--	--
1093						

Pyrometric cone equivalent: ND**Bloating test:** Negative

*Munsell designation

Remarks: Abrupt vitrification (1800-1900°F).

Potential uses: Not suitable for use in vitreous clay products.

GREENE COUNTY Franklin Twp. Waynesburg quad.

Sample number **19-A-11**

Location: Exposure along the east side of Interstate Route 79, about 4300 feet (1310 m) northwest of the place where Route 79 passes over South Fork Tenmile Creek.

Latitude: 39°54'47"N

Longitude: 80°09'33"W

Geologic unit: Waynesburg Formation, Dunkard Group

Description: Brownish-black carbonaceous fissile shales occur for an interval of 5 feet (1.5 m) above a partially exposed coal. Stratigraphically the shale is probably close to the Waynesburg "A" coal. The shale breaks down into papery to platy fragments having angular edges. No effervescence was noted when the shale was treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Composite of 5 feet (1.5 m) of shale

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	41.00	Quartz	10	Water of plasticity (%): --
TiO ₂	0.69	Mica	58	Drying shrinkage (%): --
Al ₂ O ₃	20.05	Kaolinite	14	Workability: Short
Fe ₂ O ₃	10.40	Chlorite-		Dry strength: --
MnO	0.178	vermiculite	0	Drying defects: None
MgO	1.29	Feldspar	2	pH: 8.0
CaO	0.49	Montmo-		
Na ₂ O	0.18	rillonite	10	
K ₂ O	2.51	Calcite	1	
		Siderite	5	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	--	--	No bond	--	--	--
982						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: No bond strength.

Bloating tests (quick-firing):Crushing characteristics: **Platy**Particle size: **-3/4" (1.9 cm) lumps**Retention time: **15 min.**

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	1.88	117.3	18.7	No expansion.
982				
1900	1.58	98.6	19.3	Partial expansion.
1038				
2000	0.90	56.2	22.0	Good pore structure.
1093				
2100	0.89	55.5	28.9	Overfired.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Potential uses: Marginal raw material for lightweight aggregate. Short range.
Might have to be pelletized.

GREENE COUNTY Franklin Twp. Waynesburg quad.Sample number **19-A-12A**

Location: Inactive quarry formerly used by the Greene County Clay Products Company, located northwest of the brick kilns, about 7900 feet (2410 m) southwest of Waynesburg.

Latitude: 39°52'38"N**Longitude:** 80°12'02"W**Geologic unit:** Waynesburg Formation, Dunkard Group

Description: Light-olive-brown to pale-olive shales grade down into grayish-red to dark-reddish-brown claystones in the sampled interval of 16 feet (5 m). This interval lies immediately below a sandstone unit at the top of the quarry. Two limestone beds, each 3-1/2 inches (8.9 cm) thick, occur in the upper 5 feet (1.5 m) of the sampled interval. The shales break down into platy fragments, whereas the claystones form hackly fragments having angular edges. The claystones effervesce freely when treated with dilute hydrochloric acid, whereas the reaction of the shales to the acid is weak to negative.

Attitude of bedding: N70E, 4N**Weathering intensity:** Slight to moderate**Sampled interval:** Composite through 16 stratigraphic feet (5 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	50.40	Quartz	15	Water of plasticity (%): 20.8	
TiO ₂	0.75	Mica	67	Drying shrinkage (%): 5.0	
Al ₂ O ₃	17.35	Kaolinite	3	Workability: Plastic	
Fe ₂ O ₃	6.23	Chlorite-		Dry strength: Good	
MnO	0.075	vermiculite	2	Drying defects: None	
MgO	1.66	Feldspar	3	pH: 8.4	
CaO	7.22	Montmo-			
Na ₂ O	0.38	rillonite	6		
K ₂ O	3.57	Calcite	4		

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Brownish orange	3	5.0	18.4	32.2	1.76
982	(2.5YR5/8)					
1900	Grayish reddish	3	7.5	17.0	30.5	1.80
1038	orange (2.5YR5/6)					
2000	Grayish reddish	5	7.5	15.2	27.9	1.84
1093	orange (2.5YR5/6)					
2100	Strong brown	6	7.5	14.4	27.0	1.87
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F).

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

GREENE COUNTY Franklin Twp. Waynesburg quad.

Sample number 19-A-12B

Location: Inactive quarry formerly used by the Greene County Clay Products Company, located northwest of the brick kilns, about 7900 feet (2410 m) southwest of Waynesburg.

Latitude: 34°52'42"N

Longitude: 80°12'05"W

Geologic unit: Waynesburg Formation, Dunkard Group

Description: Dark-greenish-gray interbedded claystone and shale occurs from 10 to 16 feet (3 to 5 m) below a sandstone unit. Some of the beds are calcareous. The material breaks down into hackly, platy, and slabby fragments having angular edges.

Attitude of bedding: N70E, 4N

Weathering intensity: Slight

Sampled interval: Channel sample through 6 stratigraphic feet (1.8 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	55.30	Quartz	21	Water of plasticity (%): 20.2
TiO ₂	1.40	Mica	55	Drying shrinkage (%): 5.0
Al ₂ O ₃	20.45	Kaolinite	13	Workability: Plastic
Fe ₂ O ₃	7.40	Chlorite-		Dry strength: Good
MnO	0.107	vermiculite	5	Drying defects: None
MgO	2.45	Feldspar	6	pH: 8.6
CaO	1.78	Montmo-		
Na ₂ O	0.63	rillonite	0	
K ₂ O	3.70	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Mod. orange yellow to light yellowish brown (7.5YR7/6)	2	5.0	17.6	31.9	1.80
1900 1038	Light brown to mod. orange (5YR6/6)	3	5.0	14.2	27.0	1.91
2000 1093	Moderate reddish brown (2.5YR4/4)	6	10.0	8.7	18.2	2.10
2100 1149	Moderate reddish brown (2.5YR4/4)	6	10.0	7.6	16.1	2.12
2200 1204	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F).

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

GREENE COUNTY Franklin Twp. Waynesburg quad.

Sample number 19-A-12C

Location: Inactive quarry formerly operated by the Greene County Clay Products Company, located northwest of the brick kilns, about 7900 feet (2410 m) southwest of Waynesburg.

Latitude: 39°52'42"N

Longitude: 80°12'05"W

Geologic unit: Waynesburg Formation, Dunkard Group

Description: Dark-greenish-gray shales, interbedded with some claystones, occur stratigraphically below the materials collected as sample 19-A-12B. The shales and claystones break down to form platy or hackly fragments having angular edges; most of them are calcareous.

Attitude of bedding: N70E, 4N

Weathering intensity: Slight

Sampled interval: Channel through 6 stratigraphic feet (1.8 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	52.60	Quartz	21	Water of plasticity (%): 20.9
TiO ₂	0.95	Mica	52	Drying shrinkage (%): 5.0
Al ₂ O ₃	20.75	Kaolinite	0	Workability: Plastic
Fe ₂ O ₃	8.80	Chlorite-		Dry strength: Good
MnO	0.110	vermiculite	7	Drying defects: None
MgO	2.44	Feldspar	6	pH: 8.6
CaO	0.93	Montmo-		
Na ₂ O	0.60	rillonite	10	
K ₂ O	3.64	Calcite	1	
		Siderite	3	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Mod. yellowish pink to	2	5.0	18.6	32.8	1.77
982	mod. orange (5YR7/6)					
1900	Light brown to mod.	3	7.5	17.8	32.1	1.80
1038	orange (5YR6/6)					
2000	Grayish reddish	3	10.0	12.2	23.9	1.97
1093	orange (2.5YR5/6)					
2100	Strong brown	4	10.0	11.9	23.5	1.97
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F).

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

GREENE COUNTY Franklin Twp. Waynesburg quad.Sample number **19-A-13**

Location: Small pit along the west side of U.S. Route 19, about 1500 feet (460 m) southeast of the intersection of U.S. Route 19 and Pa. Route 21 in the village of Morrisville.

Latitude: 39°53'32"N

Longitude: 80°09'35"W

Geologic unit: Waynesburg Formation, Dunkard Group

Description: Light-olive-gray, yellow-gray, and dusky-yellow claystones are exposed stratigraphically beneath a 15-inch (38-cm) sandstone bed in a small quarry. This interval probably belongs in the upper part of the Waynesburg Formation. The claystones break into hackly to slabby fragments having angular edges.

Attitude of bedding: N30E, 5SE**Weathering intensity:** Moderate to severe**Sampled interval:** Channel through 7 stratigraphic feet (2.1 m)**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	57.20	Quartz	19	Water of plasticity (%): 24.8
TiO ₂	0.94	Mica	62	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.50	Kaolinite	0	Workability: Plastic
Fe ₂ O ₃	6.68	Chlorite-		Dry strength: Good
MnO	0.075	vermiculite	3	Drying defects: None
MgO	1.54	Feldspar	5	pH: 8.2
CaO	1.22	Montmo-		
Na ₂ O	0.53	rillonite	10	
K ₂ O	3.65	Calcite	0	
		Siderite	1	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	3	5.0	15.4	28.6	1.86
982	(5YR6/8)					
1900	Grayish reddish	4	10.0	8.4	17.8	2.11
1038	orange (2.5YR5/6)					
2000	Moderate reddish	6	15.0	1.9	4.5	2.36
1093	brown (2.5YR4/4)					
2100	Moderate reddish	7	15.0	0.8	1.8	2.37
1149	brown (2.5YR4/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative

*Munsell designation

Remarks: Abrupt vitrification (1900-2000°F). Slight effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

GREENE COUNTY Jefferson Twp. Mather quad.

Sample number **19-B-14**

Location: Exposure along the north side of Pa. Route 188, about 2500 feet (760 m) southwest from the Jefferson Morgan High School in the village of Jefferson.

Latitude: 39°55'23"N

Longitude: 80°04'17"W

Geologic unit: Waynesburg Formation, Dunkard Group

Description: Grayish-black underclay, 13 inches (33 cm) thick, occurs between two coals, each coal measuring 36 inches (91 cm) in thickness. The underclay breaks into hackly fragments. It does not effervesce when treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 13 inches (33 cm) of underclay

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	60.60	Quartz	28	Water of plasticity (%): 22.3
TiO ₂	1.29	Mica	45	Drying shrinkage (%): 5.0
Al ₂ O ₃	26.85	Kaolinite	21	Workability: Plastic
Fe ₂ O ₃	2.15	Chlorite-		Dry strength: Good
MnO	0.005	vermiculite	0	Drying defects: None
MgO	0.67	Feldspar	1	pH: 4.4
CaO	0.11	Montmo-		
Na ₂ O	0.26	rillonite	5	
K ₂ O	1.91	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Yellowish white	3	5.0	17.9	31.8	1.78
982	(10YR9/2)					
1900	Yellowish white	3	7.5	16.1	29.5	1.83
1038	(10YR9/2)					
2000	Yellowish white	5	10.0	11.9	23.3	1.96
1093	(2.5Y9/2)					
2100	Yellowish white	6	10.0	11.3	22.5	1.98
1149	(2.5Y9/2)					

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color*</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2200	Pale to grayish	7	12.5	3.8	8.3	2.19
1204	yellow (2.5Y8/4)					
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F).

Potential uses: Type FBS facing brick. Structural tile (facing).

*Munsell designation

GREENE COUNTY Whiteley Twp. Garards Fort quad.

Sample number **19-D-4A**

Location: Pennsylvania Department of Transportation drill hole BH 9-70, Station 3 + 00, Ramp B, for Interstate Route 79, located about 7800 feet (2380 m) east-northeast of Kirby. Drill hole collared at elevation of 1140.35 feet (347.6 m).

Latitude: 39°48'26"N

Longitude: 80°05'24"W

Geologic unit: Washington Formation, Dunkard Group

Description: Very light gray to light-gray claystones were penetrated between depths of 6 to 19 feet (1.8 to 5.8 m) in the drill hole. A short interval of silty and sandy material is present between 15.5 and 16 feet (4.7 and 4.9 m). Colors change to mottled yellow green, yellow orange, and reddish brown with depth.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Entire core from 6 to 19 feet (1.8 to 5.8 m)

Chemical analysis: **Mineralogy (X-ray):** **Raw properties:**

	%		%	
SiO ₂	56.80	Quartz	29	Water of plasticity (%): 20.0
TiO ₂	1.08	Mica	45	Drying shrinkage (%): 5.0
Al ₂ O ₃	20.25	Kaolinite	14	Workability: Plastic
Fe ₂ O ₃	5.21	Chlorite-		Dry strength: Good
MnO	0.023	vermiculite	7	Drying defects: None
MgO	1.22	Feldspar	2	pH: 6.7
CaO	0.33	Montmo-		
Na ₂ O	0.46	rillonite	3	
K ₂ O	3.43	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	5	7.5	15.0	27.6	1.84
982						
1900	Tan	5	7.5	10.0	20.3	2.03
1038						
2000	Orange tan	6	10.0	4.4	9.8	2.23
1093						
2100	Light brown	6	15.0	2.1	4.9	2.31
1149						
2200	Medium brown	7.5	10.0	0.0	0.0	2.33
1204						
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2100°F. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; sewer pipe; Type M floor brick.

GREENE COUNTY Whiteley Twp. Garards Fort quad.

Sample number 19-D-4B

Location: Pennsylvania Department of Transportation drill hole BH 9-70, Station 3 + 00, Ramp B for Interstate Route 79, located about 7800 feet (2380 m) east-northeast of Kirby. Drill hole collared at elevation of 1140.35 feet (347.6 m).

Latitude: 39°48'26"N

Longitude: 80°05'24"W

Geologic unit: Washington Formation, Dunkard Group

Description: Yellow-gray to dusky-yellow, interbedded shaly siltstones and silty shales were penetrated between 21.5 and 31.5 feet (6.6 and 9.6 m) in the drill hole. No effervescence when treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Entire core between 21.5 and 31.5 feet (6.6 and 9.6 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

%	
SiO ₂	70.20
TiO ₂	0.82
Al ₂ O ₃	14.40
Fe ₂ O ₃	5.41
MnO	0.077
MgO	1.20

%	
Quartz	33
Mica	30
Kaolinite	11
Chlorite- vermiculite	0
Feldspar	15

Water of plasticity (%):	19.5
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	8.1

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	0.53	Montmo-	
Na ₂ O	1.82	rillonite	11
K ₂ O	1.95	Calcite	0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	17.7	31.5	1.78
982						
1900	Orange tan	3	5.0	16.9	30.4	1.80
1038						
2000	Light brown	5	5.0	13.9	26.3	1.89
1093						
2100	Dark red	5	10.0	6.4	13.7	2.14
1149						
2200	Red brown	7	10.0	2.0	4.4	2.22
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative
Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe;
 Type H floor brick.

GREENE COUNTY Whiteley Twp. Garards Fort quad.Sample number **19-D-4C**

Location: Pennsylvania Department of Transportation drill hole BH 9-70, Station 3 + 00, Ramp B for Interstate Route 79, located about 7800 feet (2380 m) east-northeast of Kirby. Drill hole collared at elevation of 1140.35 feet (347.6 m).

Latitude: 39°48'26"N**Longitude:** 80°05'24"W**Geologic unit:** Washington Formation, Dunkard Group

Description: Dusky-yellow to yellow-orange shales grading down to greenish-gray and medium-light-gray shales were penetrated between depths of 32 and 39 feet (9.8 and 11.9 m) in the drill hole. No effervescence occurred when the shales were treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Negligible**Sampled interval:** Entire core between 32 and 39 feet (9.8 and 11.9 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	66.20	Quartz	30	Water of plasticity (%): 21.6
TiO ₂	0.88	Mica	43	Drying shrinkage (%): 5.0
Al ₂ O ₃	16.05	Kaolinite	11	Workability: Plastic
Fe ₂ O ₃	6.40	Chlorite-		Dry strength: Good
MnO	0.048	vermiculite	1	Drying defects: None
MgO	1.50	Feldspar	9	pH: 7.9
CaO	0.57	Montmo-		
Na ₂ O	1.53	rillonite	6	
K ₂ O	2.42	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	7.5	16.7	30.4	1.82
982						
1900	Orange tan	3	7.5	13.2	25.7	1.95
1038						
2000	Light brown	6	10.0	4.9	10.9	2.22
1093						
2100	Medium brown	6	15.0	1.4	3.2	2.33
1149						
2200	Dark brown	7	10.0	0.7	1.5	2.22
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2100°F.

Potential uses: Grade SW building brick; Type M floor brick.

GREENE COUNTY Whiteley Twp. Garards Fort quad.

Sample number 19-D-4D

Location: Pennsylvania Department of Transportation drill hole BH 9-70, Station 3 + 00, Ramp B for Interstate Route 79, located about 7800 feet (2380 m) east-northeast of Kirby. Drill hole collared at elevation of 1140.35 feet (347.6 m).

Latitude: 39°48'26"N

Longitude: 80°05'24"W

Geologic unit: Washington Formation, Dunkard Group

Description: Medium-light-gray to greenish-gray, very calcareous mudstones and shales were penetrated between depths of 39 and 58 feet (11.9 and 17.7 m). They were highly effervescent when treated with hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Entire core between depths of 39 and 58 feet (11.9 and 17.7 m)

Chemical analysis:

	%
SiO ₂	43.20
TiO ₂	0.65
Al ₂ O ₃	15.0
Fe ₂ O ₃	5.97
MnO	0.146
MgO	1.97
CaO	13.00
Na ₂ O	0.39
K ₂ O	3.22

Mineralogy (X-ray):

	%
Quartz	14
Mica	67
Kaolinite	6
Chlorite-vermiculite	0
Feldspar	5
Montmorillonite	2
Calcite	6

Raw properties:

Water of plasticity (%): 19.2
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 8.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Orange tan	3	7.5	21.4	36.1	1.69
982						
1900	Tan	3	7.5	20.6	35.4	1.72
1038						
2000	Tan	5	7.5	20.1	34.6	1.72
1093						
2100	Buff	6	10.0	10.7	21.1	1.97
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color, high absorption at 2000°F. Abrupt vitrification.

Potential uses: Grade MW building brick; Type FBS facing brick; structural tile (facing).

GREENE COUNTY Whiteley Twp. Garards Fort quad.

Sample number **19-D-4E**

Location: Pennsylvania Department of Transportation drill hole BH 9-70, Station 3 + 00, Ramp B for Interstate Route 79, located about 7800 feet (2380 m) east-northeast of Kirby. Drill hole collared at elevation of 1140.35 feet (347.6 m).

Latitude: 39°48'26"N

Longitude: 80°05'24"W

Geologic unit: Washington Formation, Dunkard Group

Description: Grayish-red and greenish-gray shales were penetrated between depths of 58 and 75 feet (17.7 and 22.9 m). Some of them effervesced when treated with hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Entire core between depths of 58 and 75 feet (17.7 and 22.9 m)

Chemical analysis:

	%
SiO ₂	50.70
TiO ₂	0.77
Al ₂ O ₃	15.60
Fe ₂ O ₃	6.15
MnO	0.114
MgO	2.0
CaO	7.76
Na ₂ O	0.39
K ₂ O	3.69

Mineralogy (X-ray):

	%
Quartz	18
Mica	37
Kaolinite	4
Chlorite-vermiculite	0
Feldspar	1
Montmorillonite	20
Calcite	4
Pyrite	3
Siderite	2

Raw properties:

Water of plasticity (%): 19.6
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 9.0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light brown	3	2.5	18.4	32.5	1.73
982						
1900	Light brown	3	2.5	18.3	31.8	1.74
1038						
2000	Light brown	3	5.0	16.9	29.4	1.78
1093						
2100	Dark brown	5	5.0	13.8	23.8	1.73
1149						
2200	--	--	Melted	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Low plasticity, limy, abrupt vitrification (2100-2200°F).

Potential uses: Not suitable for use in vitreous clay products.

GREENE COUNTY Whiteley Twp. Garards Fort quad.Sample number **19-D-4F**

Location: Pennsylvania Department of Transportation drill hole BH 9-70, Station 3 + 00, Ramp B for Interstate Route 79, located about 7800 feet (2380 m) east-northeast of Kirby. Drill hole collared at elevation of 1140.35 feet (347.5 m).

Latitude: **39°48'26"N**Longitude: **80°05'24"W**

Geologic unit: Washington Formation, Dunkard Group

Description: Greenish-gray shales grading down to shaly siltstones were penetrated between depths of 75 and 90 feet (22.9 and 27.4 m). Some effervescence locally in interval when treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Entire core between depths of 75 and 90 feet (22.9 and 27.4 m)

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	64.30	Quartz	38	Water of plasticity (%): 18.0
TiO ₂	0.97	Mica	35	Drying shrinkage (%): 2.5
Al ₂ O ₃	15.50	Kaolinite	11	Workability: Short
Fe ₂ O ₃	5.40	Chlorite-		Dry strength: Poor
MnO	0.052	vermiculite	5	Drying defects: None
MgO	1.56	Feldspar	11	pH: 8.9
CaO	1.05	Montmo-		
Na ₂ O	1.32	rillonite	0	
K ₂ O	2.42	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	18.8	32.6	1.73
982						
1900	Orange tan	3	5.0	18.3	32.2	1.76
1038						
2000	Light brown	3	5.0	15.9	29.1	1.83
1093						
2100	Red brown	5	5.0	12.0	23.1	1.92
1149						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2200	Dark brown	7	10.0	2.6	5.9	2.22
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Fair color (2100°F). Abrupt vitrification (2100-2200°F).

Potential uses: Grade SW building brick; Type FBS facing brick.

GREENE COUNTY Whiteley Twp. Garards Fort quad.

Sample number 19-D-5A

Location: Pennsylvania Department of Transportation drill hole S 7 for LR 1030, Section 10, located about 12,300 feet (3750 m) southeast of Kirby. Hole collared at elevation of 1272.83 feet (388.0 m).

Latitude: 39°47'16"N

Longitude: 80°04'40"W

Geologic unit: Washington Formation, Dunkard Group

Description: Light-gray, light-olive-gray, and medium-gray shaly siltstones grade stratigraphically down to medium-gray shales between depths of 12 and 20 feet (3.7 and 6.1 m) in the drill hole. Locally some effervescence was noted when the core was treated with hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Entire core between depths of 12 and 20 feet (3.7 and 6.1 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	63.10	Quartz	17	Water of plasticity (%): 20.7
TiO ₂	0.95	Mica	58	Drying shrinkage (%): 2.5
Al ₂ O ₃	18.70	Kaolinite	11	Workability: Plastic
Fe ₂ O ₃	7.15	Chlorite-		Dry strength: Fair
MnO	0.077	vermiculite	3	Drying defects: None
MgO	1.58	Feldspar	7	pH: 7.6

Chemical analysis: **Mineralogy (X-ray):**

	%		%
CaO	0.50	Montmo-	
Na ₂ O	0.84	rillonite	4
K ₂ O	3.07	Calcite	0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Tan	3	5.0	17.6	31.6	1.80
1900 1038	Tan	3	5.0	14.3	27.0	1.89
2000 1093	Light brown	5	10.0	7.6	16.2	2.13
2100 1149	Red brown	5	10.0	2.6	6.1	2.29
2200 1204	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND**Bloating test:** Positive**Remarks:** Fair color at 2100°F in slow-firing tests.**Bloating tests (quick-firing):**

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800 982	1.67	104.4	10.7	No expansion.
1900 1038	1.64	102.6	10.5	No expansion.
2000 1093	0.95	59.7	11.3	Good pore structure.
2100 1149	0.84	52.6	14.1	Fair pore structure.
2200 1204	--	--	--	--
2300 1260	--	--	--	--

Potential uses: Grade SW building brick; Type H floor brick; promising raw material for lightweight aggregate.

GREENE COUNTY Whiteley Twp. Garards Fort quad.Sample number **19-D-5B**

Location: Pennsylvania Department of Transportation drill hole S 7 for LR 1030, Section 10, located about 12,300 feet (3750 m) southeast of Kirby. Hole collared at elevation of 1272.83 feet (388.0 m).

Latitude: 39°47'16"N

Longitude: 80°04'40"W

Geologic unit: Washington Formation, Dunkard Group

Description: Medium-dark-gray shales grade rapidly downward to greenish-gray shaly siltstones between the depths of 23 and 35 feet (7.0 and 10.7 m) in the drill hole. Entire sequence effervesces when treated with dilute hydrochloric acid. Some intervals in the sequence effervesce moderately, whereas others show only a slight reaction.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Negligible

Sampled interval: Entire core between depths of 23 and 35 feet (7.0 and 10.7 m)

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	> 70.00	Quartz	28	Water of plasticity (%): 17.0
TiO ₂	0.86	Mica	52	Drying shrinkage (%): 0.0
Al ₂ O ₃	11.75	Kaolinite	5	Workability: Short
Fe ₂ O ₃	5.50	Chlorite-		Dry strength: Fair
MnO	0.127	vermiculite	5	Drying defects: None
MgO	1.11	Feldspar	8	pH: 8.4
CaO	4.28	Montmo-		
Na ₂ O	1.37	rillonite	0	
K ₂ O	1.65	Calcite	2	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	15.5	29.1	1.87
982						
1900	Tan	3	5.0	13.5	26.6	1.97
1038						
2000	Light brown	6	5.0	11.3	23.1	2.04
1093						
2100	Red brown	6	10.0	3.8	8.7	2.28
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Positive**Remarks:** Fair color at 2100°F in slow-firing tests.

Bloating tests (quick-firing):Crushing characteristics: **Angular**Particle size: **-3/4" (1.9 cm) lumps**Retention time: **15 min.**

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	1.99	124.0	7.7	No expansion.
982				
1900	1.83	114.1	8.8	No expansion.
1038				
2000	1.47	91.1	9.1	Laminar expansion.
1093				
2100	1.03	64.3	10.3	Good pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Potential uses: Grade SW building brick; Type H floor brick; promising raw material for lightweight aggregate (may be a mixture of low- and high-temperature bloating materials).

GREENE COUNTY Whiteley Twp. Garards Fort quad.Sample number **19-D-5C**

Location: Pennsylvania Department of Transportation drill hole S 7 for LR 1030, Section 10, located about 12,300 feet (3750 m) southeast of Kirby. Hole collared at elevation of 1272.83 feet (388.0 m).

Latitude: 39°47'16"N**Longitude:** 80°04'40"W**Geologic unit:** Washington Formation, Dunkard Group

Description: Greenish-gray interbedded shaly siltstones and silty shales were penetrated between depths of 35 and 45 feet (10.7 and 13.7 m). The entire interval showed a moderate amount of effervescence when treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Negligible

Sampled interval: Entire core between depths of 35 and 45 feet (10.7 and 13.7 m)

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	50.80	Quartz	20	Water of plasticity (%): 17.8
TiO ₂	0.85	Mica	62	Drying shrinkage (%): 0.0
Al ₂ O ₃	14.85	Kaolinite	7	Workability: Short
Fe ₂ O ₃	10.54	Chlorite-		Dry strength: Poor
MnO	0.147	vermiculite	6	Drying defects: None
MgO	2.17	Feldspar	3	pH: 9.1

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	4.72	Montmo-	
Na ₂ O	0.28	rillonite	0
K ₂ O	2.39	Calcite	2

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	19.5	34.9	1.78
982						
1900	Light brown	3	5.0	19.4	34.6	1.79
1038						
2000	Light brown	3	5.0	19.2	34.5	1.79
1093						
2100	Red brown	5	5.0	13.3	25.9	1.95
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Fair color at 2100°F. Abrupt vitrification (2100-2200°F).

Potential uses: Grade MW building brick.

GREENE COUNTY Cumberland Twp. Carmichaels quad.

Sample number **29-A-7**

Location: Exposure along the south side of a medium-duty road which trends eastward through Cumberland Village. The exposure occurs near the bend in the road near the waterworks west of the Monongahela River.

Latitude: 39°54'06"N

Longitude: 79°55'54"W

Geologic unit: Uniontown Formation, Monongahela Group

Description: Greenish-gray claystone and silty claystone are exposed for an interval of 10 feet (3 m), but cover at the base may mask an additional 6 to 7 feet (1.8 to 2.1 m) of the same type of material. Partings in the claystone commonly do not exceed 5 inches (13 cm). Fragments are usually hackly, chippy, or slabby and have angular edges.

Attitude of bedding: N45W, 4SW

Weathering intensity: Slight to moderate

Sampled interval: Composite through 10 stratigraphic feet (3 m)

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	58.40	Quartz	25	Water of plasticity (%): 22.0
TiO ₂	1.07	Mica	51	Drying shrinkage (%): 5.0
Al ₂ O ₃	18.00	Kaolinite	15	Workability: Plastic
Fe ₂ O ₃	7.50	Chlorite-		Dry strength: Good
MnO	0.091	vermiculite	2	Drying defects: None
MgO	1.70	Feldspar	7	pH: 7.8
CaO	0.58	Montmo-		
Na ₂ O	1.00	rillonite	0	
K ₂ O	2.97	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light brown to mod.	3	5.0	17.2	31.5	1.83
982	orange (5YR6/6)					
1900	Light brown to brown-	3	7.5	13.1	25.5	1.95
1038	ish orange (5YR5/6)					
2000	Moderate reddish	6	10.0	6.0	13.2	2.22
1093	brown (2.5YR4/4)					
2100	Moderate reddish	6	10.0	4.2	9.4	2.26
1149	brown (2.5YR4/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.**Potential uses:** Type FBS facing brick.

*Munsell designation

GREENE COUNTY Wayne Twp. Blacksville quad.Sample number **110-A-5****Location:** Exposure along the west side of an unimproved road that parallels the course of Sheppards Run. The exposure occurs about 4600 feet (1400 m) north of this road's junction with Pa. Route 218.**Latitude:** 39°44'18"N**Longitude:** 80°12'47"W**Geologic unit:** Washington Formation, Dunkard Group**Description:** Two feet (0.7 m) of olive-black to brownish-black shale overlies 7 feet (2.1 m) of light-olive-gray claystone. All rock materials effervesce freely when treated with dilute hydrochloric acid. The shale breaks down into platy fragments, whereas the claystone forms hackly fragments. Iron staining is present locally in fractures.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate to slight

Sampled interval: Channel through 9 stratigraphic feet (2.7 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	47.40	Quartz	12	Water of plasticity (%): 22.0
TiO ₂	0.75	Mica	76	Drying shrinkage (%): 5.0
Al ₂ O ₃	16.10	Kaolinite	4	Workability: Plastic
Fe ₂ O ₃	5.75	Chlorite-		Dry strength: Good
MnO	0.135	vermiculite	0	Drying defects: None
MgO	1.40	Feldspar	3	pH: 8.4
CaO	7.70	Montmo-		
Na ₂ O	0.42	rillonite	1	
K ₂ O	3.28	Calcite	4	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Mod. yellowish pink to	3	5.0	20.5	34.7	1.69
982	mod. orange (5YR7/6)					
1900	Mod. yellowish pink to	3	7.5	20.0	34.0	1.70
1038	mod. orange (5YR7/6)					
2000	Light brown	7	7.5	15.9	28.8	1.81
1093	(7.5YR6/4)					
2100	Light yellowish	7	7.5	14.8	27.1	1.83
1149	brown (10YR6/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F).

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

GREENE COUNTY Perry Twp. Osage quad.

Sample number **110-B-3**

Location: Pennsylvania Department of Transportation drill hole S 11 for LR 1030, Section 11, located about 4,000 feet (1220 m) north-northeast of the village of Mount Morris.

Latitude: 39°44'34"N

Longitude: 80°03'48"W

Geologic unit: Uniontown Formation, Monongahela Group

Description: Medium-gray noncalcareous underclay to the Waynesburg(?) coal was penetrated between 38.5 and 43 feet (11.7 and 13.1 m) in the drill hole. A thin, 2-inch (5-cm) bed of sandstone lies directly beneath the underclay.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Entire core between 38.5 and 43 feet (11.7 and 13.1 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	57.20	Quartz	33	Water of plasticity (%): 20.0
TiO ₂	1.12	Mica	51	Drying shrinkage (%): 2.5
Al ₂ O ₃	17.70	Kaolinite	8	Workability: Short
Fe ₂ O ₃	5.65	Chlorite-		Dry strength: Fair
MnO	0.083	vermiculite	6	Drying defects: None
MgO	1.47	Feldspar	2	pH: 6.5
CaO	0.32	Montmo-		
Na ₂ O	0.42	rillonite	0	
K ₂ O	3.19	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	19.1	32.9	1.72
982						
1900	Orange tan	3	5.0	17.7	31.3	1.76
1038						
2000	Orange tan	4	5.0	13.1	25.0	1.91
1093						
2100	Light brown	5	7.5	9.5	18.9	1.99
1149						
2200	Dark brown	8	10.0	3.5	7.7	2.20
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor colors in slow-firing tests. No effervescence when treated with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	1.92	119.9	8.1	No expansion.
982				
1900	1.57	97.9	12.2	No expansion.
1038				

Bloating tests (quick-firing):

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
2000 1093	1.23	76.6	14.0	Laminar expansion.
2100 1149	1.22	76.3	10.7	Laminar expansion.
2200 1204	--	--	--	--
2300 1260	--	--	--	--

Remarks: Not suitable for lightweight aggregate (heavy).

Potential uses: Grade SW building brick; drain tile.

GREENE COUNTY Perry Twp. Osage quad.

Sample number 110-B-4A

Location: Pennsylvania Department of Transportation drill hole C 1 for LR 1030, Section 11, located about 3000 feet (910 m) southeast of the village of Mount Morris. Drill hole collared at elevation of 988.1 feet (301.2 m).

Latitude: 39°43'43"N Longitude: 80°03'34"W

Geologic unit: Waynesburg Formation, Dunkard Group

Description: Medium- to medium-dark-gray, noncalcareous shale was penetrated between depths of 32 and 37-1/2 feet (9.8 and 11.4 m) in the hole. The shale is flanked by sandstone units both above and below. The shale interval is probably within the lower part of the Waynesburg Formation.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Entire core from 32 to 37-1/2 feet (9.8 to 11.4 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	55.80	Quartz	26	Water of plasticity (%)	30.0
TiO ₂	1.02	Mica	53	Drying shrinkage (%)	2.5
Al ₂ O ₃	19.95	Kaolinite	12	Workability	Short
Fe ₂ O ₃	8.00	Chlorite-		Dry strength	Poor
MnO	0.144	vermiculite	5	Drying defects	None
MgO	1.59	Feldspar	4	pH	5.9

Chemical analysis: Mineralogy (X-ray):

	%		%
CaO	0.47	Montmo-	
Na ₂ O	0.45	rillonite	0
K ₂ O	3.74	Calcite	0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	18.1	32.1	1.77
982						
1900	Orange tan	3	2.5	14.8	28.2	1.91
1038						
2000	Dark tan	5	5.0	9.8	20.5	2.10
1093						
2100	Light brown	6	10.0	6.3	13.9	2.19
1149						
2200	Dark brown	7	10.0	1.3	2.8	2.21
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Positive**Remarks:** Poor color in slow-firing tests.**Bloating tests (quick-firing):**

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	1.89	117.8	8.5	No expansion.
982				
1900	1.79	111.5	7.9	No expansion.
1038				
2000	1.28	79.9	9.9	Slight expansion.
1093				
2100	1.03	64.5	13.8	Fair pore structure.
1149				
2200	2.40	149.8	3.5	Melted.
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.**Potential uses:** Grade SW building brick; sewer pipe; promising raw material for lightweight aggregate.

GREENE COUNTY Perry Twp. Osage quad.Sample number **110-B-4B**

Location: Pennsylvania Department of Transportation drill hole C 1, for LR 1030, Section 11, located about 3000 feet (910 m) southeast of the village of Mount Morris. Drill hole collared at elevation of 988.1 feet (301.2 m).

Latitude: 39°43'43"N**Longitude:** 80°03'34"W**Geologic unit:** Uniontown Formation, Monongahela Group

Description: Dark-gray underclay and shale were penetrated in the drill hole between depths of 63 and 69 feet (19.2 and 21.0 m). The underclay lies directly below a split coal seam which measures a total of 8 feet (2.4 m) in thickness. The coal is probably the Waynesburg coal.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Negligible

Sampled interval: Entire core between depths of 63 and 69 feet (19.2 and 21 m)

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	41.90	Quartz	21	Water of plasticity (%): 18.2
TiO ₂	0.67	Mica	57	Drying shrinkage (%): 2.5
Al ₂ O ₃	14.55	Kaolinite	17	Workability: Short
Fe ₂ O ₃	15.92	Chlorite-		Dry strength: Poor
MnO	0.442	vermiculite	0	Drying defects: None
MgO	1.83	Feldspar	3	pH: 6.5
CaO	1.10	Montmo-		
Na ₂ O	0.24	rillonite	2	
K ₂ O	2.30	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	2	2.5	27.4	44.0	1.61
982						
1900	Beige	3	5.0	22.3	39.2	1.76
1038						
2000	Beige	6	10.0	15.8	30.9	1.96
1093						
2100	Medium brown	6	12.5	9.1	20.0	2.20
1149						
2200	Dark brown	8	15.0	0.8	1.9	2.44
1204						
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: Poor color. Effervesces slightly when treated with HCl.

Potential uses: Grade MW building brick.

GREENE COUNTY Dunkard Twp. Morgantown North quad.

Sample number 120-A-1

Location: Exposure along a haulage road used to transport fly ash from a steam electric plant; the road is located about 3200 feet (980 m) southwest of lock no. 8 along the Monongahela River.

Latitude: 39°43'19"N

Longitude: 79°55'21"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Light- to medium-gray, thin-bedded shales are exposed for a stratigraphic thickness of 21 feet (6 m). The shale breaks to form equant to blocky fragments. A thin, 0.5-foot (15.2-cm) silty limestone separates this shale from an overlying 6-foot (1.8-m) unit of mottled gray and red shale. Massive sandstones, somewhat shaly, overlie the interval of mottled shale. Stratigraphically this interval is probably in or near the Birmingham shale horizon.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Composite of 27-foot (8-m) interval of shale

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	42.70	Quartz	11	Water of plasticity (%): 16.7
TiO ₂	0.65	Mica	59	Drying shrinkage (%): 5.0
Al ₂ O ₃	13.95	Kaolinite	7	Workability: Short
Fe ₂ O ₃	5.78	Chlorite-		Dry strength: Fair
MnO	0.526	vermiculite	0	Drying defects: None
MgO	1.86	Feldspar	1	pH: 9.3
CaO	14.80	Montmo-		
Na ₂ O	0.29	rillonite	15	
K ₂ O	2.61	Calcite	7	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Orange tan	3	5.0	13.1	25.5	1.95
982						
1900	Light brown	5	5.0	9.3	19.6	2.10
1038						
2000	Light brown	5	7.5	5.5	12.5	2.25
1093						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2100	Red brown	6	7.5	2.4	5.4	2.20
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	2.20	137.4	5.2	No expansion.
1038				
2000	1.85	115.4	4.7	Laminar expansion.
1093				
2100	1.30	81.1	9.9	Slight pore formation.
1149				
2200	1.01	63.3	11.6	Good pore structure.
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; promising raw material for lightweight aggregate.

GREENE COUNTY Dunkard Twp. Morgantown North quad.

Sample number 120-A-2

Location: Exposure along a haulage road used to transport fly ash from a steam electric plant; the road is located about 3200 feet (980 m) southwest of lock no. 8 along the Monongahela River.

Latitude: 39°43'20"N

Longitude: 79°55'23"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Olive-drab, slightly silty shale which changes stratigraphically upward into tan to light-gray shale is exposed for an interval of 15 feet (5 m). Iron stains are common along fractures and bedding planes. A few siderite concretions are scattered in the interval. Shale breaks down to form splintery or chippy fragments. This sample occurs above sample 120-A-1 and the intervening clayey sandstone.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Composite of 15 feet (5 m) of shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	51.20	Quartz	16	Water of plasticity (%): 18.0
TiO ₂	0.92	Mica	75	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.55	Kaolinite	0	Workability: Plastic
Fe ₂ O ₃	8.00	Chlorite-		Dry strength: Good
MnO	0.227	vermiculite	3	Drying defects: None
MgO	1.82	Feldspar	1	pH: 8.7
CaO	0.75	Montmo-		
Na ₂ O	0.31	rillonite	5	
K ₂ O	3.26	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	12.4	24.7	1.99
982						
1900	Orange tan	4	7.5	7.5	16.3	2.18
1038						
2000	Light brown	5	10.0	2.0	4.9	2.41
1093						
2100	Red brown	6	10.0	1.2	2.9	2.41
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Potential uses: Grade SW building brick; Type FBA facing brick.

GREENE COUNTY Dunkard Twp. Morgantown North quad.

Sample number **120-A-3**

Location: Exposure along a haulage road used to transport fly ash from a steam electric plant; the road is located about 3200 feet (980 m) southwest of lock no. 8 along the Monongahela River.

Latitude: 39°43'22"N

Longitude: 79°55'24"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Thin-bedded shales, ranging in color from mottled red and greenish gray in the lower 6.5 feet (2.0 m) of the interval to gray and olive in the upper 11 feet (3.4 m), occur in this exposure. A gray limestone bed, ranging in thickness from 0.4 to 1.5 feet (0.1 to 0.5 m), occurs about 6.5 feet (2 m) above the base of the sampled interval. The shales are slightly calcareous in the lower part but become quite limy in the upper part. Iron stains are present along fractures in the shales. The shales break to form platy or equant fragments.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Composite representing 17.5 stratigraphic feet (5.3 m)**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	57.00	Quartz	22	Water of plasticity (%): 17.5
TiO ₂	0.98	Mica	48	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.55	Kaolinite	3	Workability: Plastic
Fe ₂ O ₃	7.97	Chlorite-		Dry strength: Good
MnO	0.117	vermiculite	9	Drying defects: None
MgO	1.65	Feldspar	1	pH: 9.2
CaO	2.70	Montmo-		
Na ₂ O	0.14	rillonite	15	
K ₂ O	3.16	Calcite	2	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	14.5	27.2	1.88
982						
1900	Orange tan	4	5.0	10.6	21.4	2.01
1038						
2000	Light brown	5	7.5	5.3	11.7	2.20
1093						
2100	Dark brown	6	7.5	2.0	4.6	2.29
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Poor colors.**Potential uses:** Grade SW building brick; Type FBA facing brick.

GREENE COUNTY Dunkard Twp. Morgantown North quad.Sample number **120-A-4**

Location: Exposure along a haulage road used to transport fly ash from a steam electric plant; the road is located about 3200 feet (980 m) southwest of lock no. 8 along the Monongahela River.

Latitude: 39°43'23"N**Longitude:** 79°55'26"W**Geologic unit:** Casselman Formation, Conemaugh Group

Description: Medium-gray underclay to a coal seam is exposed above the interval sampled as 120-A-3. The underclay is 2.5 feet (0.8 m) thick, has slickensides, and iron staining on the slickensides. The coal seam ranges from 0.4 to 1 foot (0.1 to 0.3 m) in thickness.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Channel through 2.5 feet (0.8 m) of underclay**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	55.50	Quartz	23	Water of plasticity (%): 24.0
TiO ₂	0.92	Mica	51	Drying shrinkage (%): 5.0
Al ₂ O ₃	18.20	Kaolinite	9	Workability: Plastic
Fe ₂ O ₃	7.10	Chlorite-		Dry strength: Good
MnO	0.031	vermiculite	0	Drying defects: None
MgO	2.00	Feldspar	2	pH: 6.5
CaO	0.30	Montmo-		
Na ₂ O	0.15	rillonite	15	
K ₂ O	3.08	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	20.1	34.1	1.70
982						
1900	Tan	3	5.0	16.2	29.4	1.81
1038						
2000	Orange tan	4	7.5	7.4	15.5	2.11
1093						
2100	Red brown	5	10.0	3.1	6.4	2.04
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Positive**Remarks:** Poor colors.

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.64	102.3	13.8	No expansion.
1038				
2000	1.61	100.4	18.3	No expansion.
1093				
2100	1.48	92.4	12.6	Slight pore formation.
1149				
2200	1.11	69.3	12.2	Good pore structure.
1204				
2300	--	--	--	Sticky.
1260				

Remarks: Promising raw material for lightweight aggregate.**Potential uses:** Grade MW building brick; Type H floor brick; promising raw material for lightweight aggregate.**GREENE COUNTY Dunkard Twp. Morgantown North quad.**Sample number **120-A-5****Location:** Exposure along a haulage road used to transport fly ash from a steam electric plant; the road is located about 3200 feet (980 m) southwest of lock no. 8 along the Monongahela River.**Latitude:** 39°43'26"N**Longitude:** 79°55'26"W**Geologic unit:** Casselman Formation, Conemaugh Group**Description:** Medium- to dark-gray, semifissile, silty roof shale occurs above the coal seam referred to in sample 120-A-4. The roof shale is 3.5 feet (1.1 m) thick. Stratigraphically above the roof shale is a flaggy to massive sandstone unit containing some shaly intervals.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Channel through 3.5 feet (1.1 m) of roof shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	48.70	Quartz	18	Water of plasticity (%):	17.6
TiO ₂	0.98	Mica	68	Drying shrinkage (%):	0.0
Al ₂ O ₃	19.10	Kaolinite	4	Workability:	Short
Fe ₂ O ₃	9.20	Chlorite-		Dry strength:	Poor
MnO	0.052	vermiculite	9	Drying defects:	None
MgO	1.90	Feldspar	1	pH:	6.9
CaO	0.40	Montmo-			
Na ₂ O	0.19	rillonite	0		
K ₂ O	3.20	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	0.0	16.3	30.2	1.86
982						
1900	Orange tan	3	0.0	13.3	26.1	1.96
1038						
2000	Orange tan	4	2.5	7.8	17.0	2.18
1093						
2100	Light brown	5	5.0	2.1	5.0	2.37
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Poor color. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; drain tile.

INDIANA COUNTY Conemaugh Twp. Avonmore quad.

Sample number 46-C-6

Location: Exposure along the north side of Pa. Route 286, about 4 miles (6.4 km) by road southwest of Clarksburg.

Latitude: 40°30'10"N

Longitude: 79°26'09"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Dark-greenish-gray, thickly laminated to very thin bedded silty shales and shaly siltstones are exposed in a roadcut estimated to be about 30 feet (9 m) high. The beds average about 1/4 inch (0.6 cm) in

thickness but reach a maximum of about 1 inch (2.5 cm). When broken, they usually form chippy to platy fragments having angular edges. Iron staining is present along fractures and bedding in moderate amounts.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 7 stratigraphic feet (2.1 m) from the lower part of the exposure

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	62.0	Quartz	22	Water of plasticity (%): 22.0
TiO ₂	1.06	Mica	58	Drying shrinkage (%): 2.5
Al ₂ O ₃	17.25	Kaolinite	7	Workability: Plastic
Fe ₂ O ₃	8.68	Chlorite-		Dry strength: Fair
MnO	0.098	vermiculite	7	Drying defects: None
MgO	2.02	Feldspar	6	pH: 8.2
CaO	0.55	Montmo-		
Na ₂ O	0.64	rillonite	0	
K ₂ O	2.70	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	2.5	16.8	31.3	1.86
982	(5YR7/6)					
1900	Moderate orange	3	5.0	13.7	27.1	1.97
1038	(2.5YR6/8)					
2000	Grayish reddish	6	5.0	9.6	20.0	2.08
1093	orange (2.5YR5/6)					
2100	Light reddish brown	7	7.5	4.6	10.5	2.26
1149	(2.5YR5/4)					
2200	Light grayish reddish	7	10.0	0.0	0.0	2.37
1204	brown (2.5YR5/2)					
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color at 2100°F. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe.

*Munsell designation

INDIANA COUNTY Armstrong Twp. McIntyre quad.Sample number **46-D-3****Location:** Exposure along the south side of Pa. Route 56, about 12,500 feet (3810 m) by road east of J M Junction.**Latitude:** 40°36'05"N**Longitude:** 79°15'18"W**Geologic unit:** Glenshaw Formation, Conemaugh Group**Description:** Dark-yellow-brown silty shales are exposed for a stratigraphic interval of about 15 feet (5 m). The beds range from thickly laminated to very thinly bedded, measuring from about 1/4 inch (0.6 cm) up to a maximum of 1 inch (2.5 cm) in thickness. The shale breaks down to form fissile to platy fragments having angular edges.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Moderate**Sampled interval:** Channel sample through the lower 10 feet (3 m) of the exposure**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	61.40	Quartz	32	Water of plasticity (%): 22.1
TiO ₂	1.00	Mica	47	Drying shrinkage (%): 2.5
Al ₂ O ₃	16.70	Kaolinite	1	Workability: Plastic
Fe ₂ O ₃	7.47	Chlorite-		Dry strength: Fair
MnO	0.101	vermiculite	11	Drying defects: None
MgO	1.69	Feldspar	4	pH: 7.6
CaO	0.20	Montmo-		
Na ₂ O	0.63	rillonite	5	
K ₂ O	2.78	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Mod. yellow pink to	2	2.5	21.9	36.9	1.69
982	mod. orange (5YR7/6)					
1900	Mod. yellow pink to	2	2.5	17.2	31.2	1.81
1038	mod. orange (5YR7/6)					
2000	Mod. orange to light	5	7.5	12.2	24.1	1.98
1093	brown (2.5YR4/4)					
2100	Grayish reddish	6	10.0	5.5	12.2	2.23
1149	brown (2.5YR4/2)					
2200	--	7	12.5	0.1	0.2	2.32
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Positive**Remarks:** Good color at 2100°F. No effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):Crushing characteristics: **Tabular**Particle size: **-3/4" (1.9 cm) lumps**Retention time: **15 min.**

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	2.00	124.8	6.9	No expansion.
1038				
2000	1.88	117.3	7.4	No expansion.
1093				
2100	1.47	91.7	7.3	Good pore structure.
1149				
2200	0.77	48.0	9.3	Some large pores.
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.**Potential uses:** Grade SW building brick; Type FBA facing brick; sewer pipe; promising raw material for lightweight aggregate.**INDIANA COUNTY Young Twp. McIntyre quad.**Sample number **46-D-4****Location:** Exposure along the northwest side of Hooper Run and a medium-duty road, located about 6,000 feet (1830 m) directly west of the town of McIntyre.**Latitude:** 40°34'11"N**Longitude:** 79°19'33"W**Geologic unit:** Glenshaw Formation, Conemaugh Group**Description:** Dark-yellow-brown shaly siltstones are exposed for a stratigraphic interval of between 15 to 20 feet (5 to 6 m). Beds are very thin, averaging less than 1 inch (2.5 cm) in thickness. Material breaks down to form platy fragments having angular edges.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Moderate**Sampled interval:** Composite through lower 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	64.40	Quartz	32	Water of plasticity (%):	22.2
TiO ₂	0.94	Mica	39	Drying shrinkage (%):	2.5
Al ₂ O ₃	17.00	Kaolinite	9	Workability:	Plastic
Fe ₂ O ₃	7.50	Chlorite-		Dry strength:	Fair
MnO	0.126	vermiculite	9	Drying defects:	None
MgO	1.68	Feldspar	7	pH:	6.4
CaO	0.12	Montmo-			
Na ₂ O	0.85	rillonite	4		
K ₂ O	2.56	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Mod. orange to light	2	2.5	22.7	38.4	1.67
982	brown (5YR6/6)					
1900	Mod. orange to light	2	2.5	19.2	32.1	1.69
1038	brown (5YR6/6)					
2000	Grayish reddish	5	5.0	12.9	25.2	1.95
1093	orange (2.5YR5/6)					
2100	Moderate reddish	6	10.0	6.1	13.4	2.20
1149	brown (2.5YR4/4)					
2200	Grayish reddish	7	10.0	0.6	1.3	2.27
1204	brown (2.5YR4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Positive

Remarks: Good color at 2100°F. No effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Tabular Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	2.10	131.0	5.4	No expansion.
1038				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i>		<i>% Absorb.</i>	<i>Remarks</i>
	<i>(gm/cc)</i>	<i>(lb/ft³)</i>		
2000	2.02	126.0	7.8	No expansion.
1093				
2100	1.60	99.8	7.0	Slight expansion.
1149				
2200	1.11	69.3	7.1	Good pore structure.
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates; promising raw material for lightweight aggregate.

INDIANA COUNTY Young Twp. McIntyre quad.

Sample number **46-D-5**

Location: Exposure along the west side of a medium-duty road which lies west of Blacklegs Creek; the exposure is located about 1 mile (1.6 km) by road northeast of Clarksburg.

Latitude: 40°32'42"N

Longitude: 79°22'12"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Olive-black to dark-greenish-gray shales and slightly silty shales are exposed for a stratigraphic interval of about 25 to 30 feet (8 to 9 m). The shale breaks down into platy fragments having angular edges. Iron staining is present along joints and bedding.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through lower 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	<i>%</i>		<i>%</i>	
SiO ₂	56.40	Quartz	23	Water of plasticity (%): 19.8
TiO ₂	0.89	Mica	57	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.00	Kaolinite	11	Workability: Plastic
Fe ₂ O ₃	8.23	Chlorite-		Dry strength: Good
MnO	0.136	vermiculite	5	Drying defects: None
MgO	2.04	Feldspar	4	pH: 6.8
CaO	0.50	Montmo-		
Na ₂ O	0.70	rillonite	0	
K ₂ O	2.85	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Mod. orange to	2	5.0	16.2	30.4	1.88
982	light brown (5YR6/6)					
1900	Light brown	4	5.0	11.4	23.1	2.02
1038	(5YR6/4)					
2000	Grayish reddish	5	10.0	5.9	13.1	2.23
1093	orange (2.5YR6/6)					
2100	Moderate reddish	7	10.0	0.9	2.1	2.36
1149	brown (2.5YR4/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor color at 2000°F. No effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Platy

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.48	91.7	14.4	Slight expansion.
1038				
2000	0.90	56.2	10.1	Some large pores.
1093				
2100	0.85	53.0	13.3	Some large pores.
1149				
2200	0.64	39.9	13.2	Many large pores.
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type M floor brick; promising raw material for lightweight aggregate.

INDIANA COUNTY Young Twp. McIntyre quad.

Sample number 46-D-7

Location: Exposure along the north side of a light-duty road, located about 6500 feet (1980 m) south-southwest of West Lebanon.

Latitude: 40°35'11"N

Longitude: 79°20'40"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Light-olive-gray, very thin bedded silty shales are exposed for a stratigraphic interval of 10 feet (3 m). The beds average between 1/4 and 1/2 inch (0.6 and 1.3 cm) in thickness and none exceed 1 inch (2.5 cm). The shale breaks into platy fragments having angular edges. Iron staining along fractures and bedding is moderate in amount. No effervescence occurs when the shale is treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	63.60	Quartz	31	Water of plasticity (%): 19.4	
TiO ₂	1.02	Mica	45	Drying shrinkage (%): 2.5	
Al ₂ O ₃	18.05	Kaolinite	7	Workability: Plastic	
Fe ₂ O ₃	7.20	Chlorite-		Dry strength: Fair	
MnO	0.084	vermiculite	8	Drying defects: None	
MgO	1.82	Feldspar	9	pH: 7.1	
CaO	0.50	Montmo-			
Na ₂ O	0.77	rillonite	0		
K ₂ O	2.45	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	2.5	15.8	29.9	1.90
982	(5YR6/8)					
1900	Moderate orange	4	5.0	12.6	24.9	1.98
1038	(2.5YR6/8)					
2000	Grayish reddish	6	7.5	7.8	16.8	2.14
1093	orange (2.5YR5/6)					
2100	Grayish reddish	7	10.0	3.9	8.9	2.30
1149	orange (2.5YR5/6)					

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2200	Light reddish brown	7	10.0	0.1	0.3	2.33
1204	(2.5YR5/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Poor color at 2000°F.

Potential uses: Grade SW building brick; Type L floor brick.

*Munsell designation

INDIANA COUNTY Black Lick Twp. Blairsville quad.

Sample number **47-B-4**

Location: Exposure along the northeast side of Pa. Route 217, about 1000 feet (300 m) south of the cemetery at Hopewell church.

Latitude: 40°28'55"N

Longitude: 79°16'03"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Dark-gray, olive-gray, and dark-greenish-gray shales are exposed for a stratigraphic interval of 12 feet (4 m). The shales break down to form platy fragments having angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel through lower 10 stratigraphic feet (3 m)

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

%		%	
SiO ₂	53.40	Quartz	16
TiO ₂	0.80	Mica	54
Al ₂ O ₃	19.95	Kaolinite	11
Fe ₂ O ₃	7.74	Chlorite-	
MnO	0.135	vermiculite	7
MgO	2.03	Feldspar	7
CaO	0.43	Montmo-	
Na ₂ O	0.96	rillonite	5
K ₂ O	3.15	Calcite	0

Water of plasticity (%): 23.4
Drying shrinkage (%): 5.0
Workability: Plastic
Dry strength: Good
Drying defects: None
pH: 7.2

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	18.1	32.8	1.82
982	(5YR6/8)					
1900	Light brown to brown-	5	7.5	12.6	25.1	1.99
1038	ish orange (5YR5/6)					
2000	Grayish reddish	6	10.0	5.3	12.1	2.28
1093	orange (2.5YR5/6)					
2100	Moderate reddish	6	12.5	0.0	0.0	2.45
1149	brown (2.5YR4/4)					
2200	--	--	--	--	--	--
1204						
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor color at 2000°F. No effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.71	106.7	7.7	Slight expansion.
1093				
2100	0.92	57.4	10.2	Some large pores.
1149				
2200	0.59	36.8	10.9	Overfired, fused.
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type L floor brick; promising raw material for lightweight aggregate.

INDIANA COUNTY Conemaugh Twp. Blairsville quad.Sample number **47-B-5**

Location: Exposure along the north side of a medium-duty road, located about 2500 feet (760 m) southwest of the place where Miller Run enters Aultmans Run.

Latitude: 40°28'32"N**Longitude:** 79°10'09"W**Geologic unit:** Glenshaw Formation, Conemaugh Group

Description: Dark-greenish-gray to olive-gray silty shales are exposed for a stratigraphic interval of 15 feet (5 m). Shales are fissile to very thinly bedded and break down to form papery to platy fragments.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Channel through lower 10 stratigraphic feet (3 m)**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

%		%		
SiO ₂	60.70	Quartz	28	Water of plasticity (%): 18.4
TiO ₂	0.88	Mica	46	Drying shrinkage (%): 2.5
Al ₂ O ₃	17.85	Kaolinite	9	Workability: Plastic
Fe ₂ O ₃	6.75	Chlorite-		Dry strength: Fair
MnO	0.078	vermiculite	11	Drying defects: None
MgO	2.13	Feldspar	6	pH: 7.4
CaO	0.31	Montmo-		
Na ₂ O	0.74	rillonite	0	
K ₂ O	2.85	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	3	2.5	14.4	27.9	1.94
982	(5YR6/8)					
1900	Moderate orange	5	5.0	9.8	20.5	2.09
1038	(2.5YR6/8)					
2000	Grayish reddish	6	10.0	3.9	9.1	2.34
1093	orange (2.5YR5/6)					
2100	Moderate reddish	7	10.0	0.0	0.0	2.42
1149	brown (2.5YR4/4)					
2200	--	--	--	--	--	--
1204						
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Positive**Remarks:** Poor color at 2000°F. No effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):Crushing characteristics: **Tabular**Particle size: **-3/4" (1.9 cm) lumps**Retention time: **15 min.**

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.49	93.0	6.2	Slight expansion.
1038				
2000	1.18	73.6	10.0	Laminar expansion.
1093				
2100	0.97	60.5	9.4	Good pore structure.
1149				
2200	0.77	48.0	10.7	Some large pores.
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.**Potential uses:** Grade SW building brick; Type L floor brick; promising raw material for lightweight aggregate.**INDIANA COUNTY South Mahoning Twp. Plumville quad.**Sample number **55-C-2****Location:** Quarry exposure along the northwest side of Pa. Route 210, about 9500 feet (2900 m) by road northeast of the village of Plumville.**Latitude:** 40°48'10"N**Longitude:** 79°09'10"W**Geologic unit:** Glenshaw Formation, Conemaugh Group**Description:** Dark-greenish-gray to olive-gray shale is exposed in the quarry. Shales are fissile and break down to form papery to platy fragments. No effervescence was noted when the shales were treated with dilute hydrochloric acid.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Channel sample through the lower 10 stratigraphic feet (3 m) of the exposure

Chemical analysis:

%

Mineralogy (X-ray):

%

Raw properties:

SiO ₂	58.80	Quartz	18	Water of plasticity (%):	19.2
TiO ₂	0.82	Mica	60	Drying shrinkage (%):	5.0
Al ₂ O ₃	19.30	Kaolinite	18	Workability:	Plastic
Fe ₂ O ₃	7.78	Chlorite-		Dry strength:	Good
MnO	0.087	vermiculite	3	Drying defects:	None
MgO	1.53	Feldspar	1	pH:	7.6
CaO	0.08	Montmo-			
Na ₂ O	0.35	rillonite	0		
K ₂ O	3.28	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Moderate orange (5YR6/8)	3	5.0	14.4	28.3	1.96
1900 1038	Moderate orange (2.5YR6/8)	5	7.5	10.3	21.7	2.10
2000 1093	Brownish orange (2.5YR5/8)	6	10.0	4.2	9.9	2.35
2100 1149	Grayish reddish orange (2.5YR5/6)	6	12.5	1.0	2.6	2.47
2200 1204	Moderate reddish brown (2.5YR3/4)	7	12.5	0.0	0.0	2.44
2300 1260	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND**Bloating test:** Positive**Remarks:** Poor color at 2000°F.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Platy

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800 982	--	--	--	--
1900 1038	1.33	83.0	6.7	Laminar expansion.

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2000	1.02	63.4	9.1	Mixed bloating and non-bloating.
1093				
2100	0.90	56.2	11.2	Mixed bloating and non-bloating.
1149				
2200	0.57	35.6	8.9	Overfired, fused.
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type M floor brick; marginal raw material for lightweight aggregate (mixture of bloating and nonbloating materials).

INDIANA COUNTY East Mahoning Twp. Marion Center quad.

Sample number **55-D-1A**

Location: Exposure along the north side of a light-duty road, about 2900 feet (880 m) south-southwest of Gilgal Church.

Latitude: 40°48'56"N

Longitude: 79°03'18"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Light-olive-gray to olive-gray silty shales are exposed in the upper half of the exposure. The beds are thin to thick, ranging from about 1-1/2 inches (3.8 cm) up to 18 inches (46 cm) in thickness. The silty shales commonly break down into flaggy or slabby fragments having angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Composite sample representing 20 stratigraphic feet (6 m)

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	<i>%</i>		<i>%</i>	
SiO ₂	59.60	Quartz	26	Water of plasticity (%): 18.7
TiO ₂	1.11	Mica	48	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.50	Kaolinite	16	Workability: Plastic
Fe ₂ O ₃	7.34	Chlorite-		Dry strength: Good
MnO	0.058	vermiculite	6	Drying defects: None
MgO	2.10	Feldspar	4	pH: 7.6

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	0.31	Montmo-	
Na ₂ O	0.62	rillonite	0
K ₂ O	3.30	Calcite	0

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	15.6	29.5	1.89
982	(5YR6/8)					
1900	Moderate orange	4	7.5	12.7	25.4	2.01
1038	(2.5YR6/8)					
2000	Grayish reddish	5	7.5	7.7	17.2	2.21
1093	orange (2.5YR5/6)					
2100	Light reddish brown	6	10.0	3.6	8.4	2.36
1149	(10R5/4)					
2200	Grayish brown	7	12.5	0.0	0.0	2.42
1204	(5YR4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Poor color at 2000°F.

Potential uses: Grade SW building brick; Type H floor brick.

*Munsell designation

INDIANA COUNTY East Mahoning Twp. Marion Center quad.

Sample number **55-D-1B**

Location: Exposure along the north side of a light-duty road, about 2900 feet (880 m) south-southeast of Gilgal Church.

Latitude: 40°48'56"N

Longitude: 79°03'18"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Olive-black to dark-gray, fissile shale occurs in the lower half of the exposure. Minor amounts of iron staining occur along fractures and bedding. The shales break down to form papery fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Composite through the lower 20 stratigraphic feet (6 m) in the exposure

Chemical analysis:

	%
SiO ₂	52.40
TiO ₂	0.87
Al ₂ O ₃	20.75
Fe ₂ O ₃	8.20
MnO	0.131
MgO	2.25
CaO	0.25
Na ₂ O	0.55
K ₂ O	3.69

Mineralogy (X-ray):

	%
Quartz	18
Mica	55
Kaolinite	13
Chlorite-vermiculite	9
Feldspar	5
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 20.1
 Drying shrinkage (%): 5.0
 Workability: Plastic
 Dry strength: Good
 Drying defects: None
 pH: 7.7

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Mod. orange to light	2	5.0	17.9	33.0	1.84
982	brown (5YR6/6)					
1900	Brownish orange to	3	7.5	13.4	26.5	1.98
1038	light brown (5YR5/6)					
2000	Grayish reddish	5	10.0	7.2	16.0	2.22
1093	orange (2.5YR6/6)					
2100	Light reddish brown	6	12.5	1.9	4.7	2.42
1149	(2.5YR5/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor color at 2000°F. No effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.13	60.5	11.1	Slight expansion.
1038				
2000	1.04	64.9	17.4	Good pore structure.
1093				

Bloating tests (quick-firing):

Temp. (°F) (°C)	Bulk density		% Absorb.	Remarks
	(gm/cc)	(lb/ft ³)		
2100	0.59	36.8	20.5	Overfired, large pores.
1149				
2200	0.50	31.2	15.0	Overfired, large pores.
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type H floor brick; promising raw material for lightweight aggregate.

INDIANA COUNTY Washington Twp. Ernest quad.

Sample number **56-A-8**

Location: Exposure along the north side of a medium-duty road, located about 6400 feet (1950 m) north of the village of Willet.

Latitude: 40°44'48"N

Longitude: 79°12'36"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Moderate-olive-brown to olive-gray shale and fissile shale are exposed from 7 to 13 feet (1.2 to 4 m) above road level. Siltstones occur stratigraphically above the shale. The interval between road level and the base of the exposed shale is masked by coals. The shale breaks down into papery to platy fragments having angular edges. No effervescence occurs when the shale is treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate to slight

Sampled interval: Channel through 6 stratigraphic feet (1.8 m) of shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	54.90	Quartz	22	Water of plasticity (%): 19.3
TiO ₂	0.95	Mica	68	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.60	Kaolinite	0	Workability: Plastic
Fe ₂ O ₃	8.10	Chlorite-		Dry strength: Good
MnO	0.086	vermiculite	8	Drying defects: None
MgO	1.84	Feldspar	2	pH: 7.4
CaO	0.30	Montmo-		
Na ₂ O	0.42	rillonite	0	
K ₂ O	3.33	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Mod. yellowish pink to	2	5.0	13.7	26.8	1.95
982	mod. orange (2.5YR7/6)					
1900	Moderate orange	3	7.5	9.8	20.4	2.09
1038	(2.5YR6/8)					
2000	Grayish reddish	5	10.0	4.9	11.4	2.33
1093	orange (2.5YR5/6)					
2100	Grayish reddish	6	12.5	1.0	2.4	2.45
1149	orange (2.5YR5/6)					
2200	Moderate reddish	7	12.5	0.0	0.0	2.42
1204	brown (2.5YR4/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Poor color at 2000°F.**Potential uses:** Grade SW building brick; Type M floor brick.

*Munsell designation

INDIANA COUNTY Washington Twp. Ernest quad.Sample number **56-A-9****Location:** Exposure along the east side of Pa. Route 954, about 4500 feet (1370 m) south-southeast of the village of Willet.**Latitude:** 40°43'07"N**Longitude:** 79°11'57"W**Geologic unit:** Glenshaw Formation, Conemaugh Group

Description: Light-olive-gray silty shales are exposed for a stratigraphic interval of about 20 feet (6 m). The beds are thickly laminated to very thinly bedded, ranging from 1/4 to about 1 inch (0.6 to 2.5 cm) in thickness. The shale breaks down into platy fragments having angular edges. When treated with dilute hydrochloric acid, the shale does not effervesce.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Moderate to slight**Sampled interval:** Channel sample through 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	60.20	Quartz	29	Water of plasticity (%): 21.8
TiO ₂	0.95	Mica	51	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.90	Kaolinite	5	Workability: Plastic
Fe ₂ O ₃	7.55	Chlorite-		Dry strength: Good
MnO	0.054	vermiculite	11	Drying defects: None
MgO	2.13	Feldspar	4	pH: 7.3
CaO	0.15	Montmo-		
Na ₂ O	0.62	rillonite	0	
K ₂ O	3.38	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	18.3	32.8	1.79
982	(2.5YR7/8)					
1900	Moderate to strong	3	5.0	15.0	28.6	1.91
1038	orange (2.5YR6/10)					
2000	Brownish orange	4	7.5	9.8	20.5	2.10
1093	(2.5YR5/8)					
2100	Grayish reddish	6	10.0	2.8	6.5	2.35
1149	orange (10R5/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Poor color at 2000°F. Stratigraphically the sample is probably about 300 feet (90 m) above the Upper Freeport coal.

Potential uses: Grade SW building brick; Type H floor brick.

*Munsell designation

INDIANA COUNTY Washington Twp. Ernest quad.

Sample number 56-A-11

Location: Exposure along the north side of Pa. Route 110, about 2000 feet (610 m) east-southeast of the village of Creekside.

Latitude: 40°40'38"N

Longitude: 79°10'54"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Grayish- to olive-green, very thin bedded silty shales grade stratigraphically down to more silty beds in a roadside exposure estimated to be about 20 feet (6 m) high. The beds range in thickness from less than 1/2 inch (1.3 cm) up to about 1 inch (2.5 cm). The silty shale breaks down into platy to slabby fragments having angular edges. No effervescence noted when the material was treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate to slight

Sampled interval: Channel through uppermost 8 feet (2.4 m) of exposure

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	58.10	Quartz	22	Water of plasticity (%): 20.4
TiO ₂	1.01	Mica	58	Drying shrinkage (%): 2.5
Al ₂ O ₃	18.20	Kaolinite	14	Workability: Plastic
Fe ₂ O ₃	7.95	Chlorite-		Dry strength: Fair
MnO	0.141	vermiculite	4	Drying defects: None
MgO	1.56	Feldspar	2	pH: 6.9
CaO	0.14	Montmo-		
Na ₂ O	0.22	rillonite	0	
K ₂ O	3.15	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Mod. yellowish pink to	2	2.5	18.0	32.5	1.81
982	mod. orange (5YR7/6)					
1900	Moderate orange	3	5.0	14.7	27.9	1.90
1038	(2.5YR6/8)					
2000	Grayish reddish	4	7.5	10.3	21.1	2.05
1093	orange (2.5YR5/6)					
2100	Moderate reddish	5	10.0	4.9	11.1	2.26
1149	brown (2.5YR4/4)					
2200	Grayish reddish	6	10.0	0.1	0.3	2.38
1204	brown (2.5YR4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Poor color at 2000°F. The sample is probably stratigraphically about 100 feet (30 m) above the Upper Freeport coal.

Potential uses: Grade SW building brick; Type H floor brick.

*Munsell designation

INDIANA COUNTY Cherryhill Twp. Clymer quad.Sample number **56-B-1**

Location: Leasure Coal Company stripping, located about 12,000 feet (3660 m) south-southwest of Clymer.

Latitude: 40°38'14"N**Longitude:** 79°01'25"W**Geologic unit:** Clarion Formation, Allegheny Group

Description: Light-gray to medium-dark-gray underclay occurs beneath a 1.2-foot (0.4-m) coal seam near the top of the highwall. The underclay is 9.4 feet (2.9 m) thick and has roots and plant debris in moderate to abundant amounts. It is a semi-hard clay and becomes subfissile in the lower 3 feet (0.9 m). The underclay is probably developed beneath the upper of two Clarion coals.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Unweathered**Sampled interval:** Composite of underclay**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	67.60	Quartz	38	Water of plasticity (%): 15.6
TiO ₂	2.20	Mica	33	Drying shrinkage (%): 2.5
Al ₂ O ₃	17.80	Kaolinite	28	Workability: Short
Fe ₂ O ₃	2.88	Chlorite-		Dry strength: Poor
MnO	0.019	vermiculite	0	Drying defects: None
MgO	0.71	Feldspar	1	pH: 3.2
CaO	0.17	Montmo-		
Na ₂ O	0.18	rillonite	0	
K ₂ O	2.47	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Peach	2	2.5	16.8	29.8	1.77
982						
1900	Peach	3	2.5	15.3	27.7	1.81
1038						
2000	Tan	3	2.5	13.1	24.9	1.90
1093						
2100	Tan	4	2.5	10.3	20.4	1.99
1149						
2200	Buff	4	2.5	7.0	14.6	2.07
1204						
2300	Gray buff	5	5.0	4.2	9.2	2.16
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: Good color at 2000°F.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

INDIANA COUNTY Cherryhill Twp. Clymer quad.

Sample number **56-B-2**

Location: Leasure Coal Company stripping located about 12,000 feet (3660 m) south-southwest of Clymer.

Latitude: 40°38'14"N

Longitude: 79°01'28"W

Geologic unit: Pottsville Group

Description: Medium- to medium-dark-gray, thinly to thickly laminated, silty underclay occurs beneath the Brookville coal. The total thickness of the underclay is not known because the upper 1.5 feet (0.5 m) is the only part that is exposed above the floor of the stripping. The underclay breaks into equant to blocky fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Upper 1.5 feet (0.5 m) of underclay

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	>75.00	Quartz	36	Water of plasticity (%): 19.7
TiO ₂	1.51	Mica	43	Drying shrinkage (%): 2.5
Al ₂ O ₃	22.30	Kaolinite	17	Workability: Plastic
Fe ₂ O ₃	2.43	Chlorite-		Dry strength: Fair
MnO	0.018	vermiculite	1	Drying defects: None
MgO	1.00	Feldspar	3	pH: 4.5
CaO	0.10	Montmo-		
Na ₂ O	0.17	rillonite	0	
K ₂ O	2.85	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	2.5	17.9	30.9	1.73
982						
1900	Peach	3	2.5	16.3	28.9	1.78
1038						
2000	Peach	3	2.5	13.9	25.8	1.86
1093						
2100	Tan	4	2.5	10.0	19.9	1.99
1149						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2200	Buff	4	5.0	5.9	12.5	2.12
1204						
2300	Gray	5	5.0	1.3	2.9	2.19
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: A stoneware-type clay of fair quality.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; stoneware.

INDIANA COUNTY Cherryhill Twp. Clymer quad.

Sample number **56-B-3**

Location: Basic Minerals Corp. stripping, located about 14,500 feet (4420 m) south of Clymer.

Latitude: 40°37'40"N

Longitude: 79°00'42"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Medium-dark-gray underclay, 7 feet (2.1 m) thick, occurs beneath a nonpersistent shaly coal which measures up to 0.1 feet (3 cm) in thickness. The underclay is soft and plastic and contains abundant siderite nodules ranging from 3 inches (7.6 cm) up to 2 feet (0.6 m) in long dimension. It breaks down upon weathering to very small, hackly fragments. Stratigraphically it probably belongs in the upper half of the Freeport Formation.

Attitude of bedding: Dips are about 3° to 5° southeast

Weathering intensity: Moderate

Sampled interval: Channel through 7 feet (2.1 m)

Chemical analysis: **Mineralogy (X-ray):** **Raw properties:**

	%		%	
SiO ₂	58.00	Quartz	19	Water of plasticity (%): 13.7
TiO ₂	1.18	Mica	54	Drying shrinkage (%): 5.0
Al ₂ O ₃	22.25	Kaolinite	22	Workability: Short
Fe ₂ O ₃	4.10	Chlorite-		Dry strength: Fair
MnO	0.026	vermiculite	0	Drying defects: None
MgO	1.44	Feldspar	3	pH: 4.6
CaO	0.36	Montmo-		
Na ₂ O	0.23	rillonite	1	
K ₂ O	3.78	Calcite	1	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	5.0	12.7	24.5	1.92
982						
1900	Tan	3	5.0	11.0	22.0	2.00
1038						
2000	Dark tan	4	5.0	7.6	16.0	2.13
1093						
2100	Light brown	5	5.0	6.1	13.2	2.18
1149						
2200	Buff	5	7.5	3.3	7.5	2.26
1204						
2300	Gray buff	6	7.5	1.1	2.5	2.27
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Fair color at 1900°F. No effervescence when treated with HCl.**Potential uses:** Grade SW building brick; Type FBS facing brick; facing tile.**INDIANA COUNTY Cherryhill Twp. Clymer quad.**Sample number **PA 56-B-4****Location:** Shick Coal Company strip mine, located about 9500 feet (2900 m) south of Clymer.**Latitude:** 40°38'32"N**Longitude:** 79°00'35"W**Geologic unit:** Clarion Formation, Allegheny Group**Description:** Light- to dark-gray, soft, plastic underclay to the Lower Kittanning coal is partially exposed for an interval of 2 feet (0.6 m) in the bottom of the stripping. Plant debris, usually dark in color, is present in the underclay. A miner working within the strip mine reported that the thickness of good underclay was about 5 to 6 feet (1.5 to 1.8 m) at this locality.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Moderate**Sampled interval:** Channel through 2 feet (0.6 m) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	>70.00	Quartz	46	Water of plasticity (%): 16.9
TiO ₂	1.63	Mica	33	Drying shrinkage (%): 2.5
Al ₂ O ₃	15.95	Kaolinite	20	Workability: Short
Fe ₂ O ₃	1.12	Chlorite-		Dry strength: Good
MnO	0.007	vermiculite	0	Drying defects: None
MgO	0.50	Feldspar	1	pH: 5.2
CaO	None	Montmo-		
Na ₂ O	0.15	rillonite	0	
K ₂ O	2.34	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Cream	3	2.5	14.0	26.1	1.86
1900 1038	Cream	3	2.5	12.9	24.5	1.90
2000 1093	Tan	3	2.5	12.0	23.3	1.94
2100 1149	Tan	4	2.5	9.9	20.0	2.02
2200 1204	Buff	4	5.0	6.2	13.2	2.14
2300 1260	Gray	5	7.5	2.5	5.6	2.20

Pyrometric cone equivalent: ND **Bloating test:** Negative

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; low-duty refractories.

INDIANA COUNTY Cherryhill Twp. Clymer quad.

Sample number **56-B-5**

Location: Shick Coal Company strip mine, located about 5500 feet (1680 m) south-southeast of Clymer.

Latitude: 40°39'13"N

Longitude: 79°00'25"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium-light to medium-dark-gray underclay to the Middle Kittanning coal is partially exposed for a distance of 2 feet (0.6 m) at the floor of the stripping. The underclay is soft, plastic, and contains abundant roots and rarely some stigmaria plant fragments. The total thickness of the underclay is not known.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Channel through 2 feet (0.6 m) of underclay

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	56.20	Quartz	20	Water of plasticity (%): 13.5
TiO ₂	2.17	Mica	31	Drying shrinkage (%): 2.5
Al ₂ O ₃	25.30	Kaolinite	47	Workability: Short
Fe ₂ O ₃	0.69	Chlorite-		Dry strength: Fair
MnO	0.006	vermiculite	0	Drying defects: None
MgO	0.25	Feldspar	1	pH: 5.5
CaO	0.10	Montmo-		
Na ₂ O	0.06	rillonite	0	
K ₂ O	0.90	Calcite	1	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Cream	3	2.5	17.7	31.2	1.76
982						
1900	Cream	3	2.5	15.6	28.5	1.83
1038						
2000	Cream	3	2.5	15.0	27.6	1.84
1093						
2100	Cream	4	2.5	14.0	26.3	1.89
1149						
2200	Tan	4	2.5	13.1	24.8	1.89
1204						
2300	Tan	4	5.0	10.7	21.1	1.94
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color at 2100°F.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; low-duty refractories.

INDIANA COUNTY Rayne Twp. Clymer quad.

Sample number 56-B-6A

Location: Quarry on the C. Ruffner property, located along the north side of Pa. Route 286, about 4.26 miles (6.9 km) west along Route 286 from Clymer.

Latitude: 40°39'52"N

Longitude: 79°05'13"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Grayish-olive to light-olive-gray, very thin to medium-bedded, interbedded silty shales and shales are exposed in the upper part of the quarry. Beds range in thickness from less than 1 inch (2.5 cm) up to about 1 foot (0.3 m). The materials break down to form chippy to slabby fragments having sharp, angular edges.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Channel through upper 10 feet (3 m) of the exposed section**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	50.60	Quartz	19	Water of plasticity (%): 19.3
TiO ₂	0.78	Mica	69	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.50	Kaolinite	0	Workability: Plastic
Fe ₂ O ₃	8.85	Chlorite-		Dry strength: Good
MnO	0.059	vermiculite	7	Drying defects: None
MgO	2.22	Feldspar	5	pH: 7.1
CaO	0.33	Montmo-		
Na ₂ O	0.64	rillonite	0	
K ₂ O	3.39	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	13.8	27.1	1.96
982	(2.5YR7/8)					
1900	Moderate orange	3	7.5	9.7	20.5	2.12
1038	(2.5YR6/8)					
2000	Brownish orange	5	7.5	4.0	9.4	2.37
1093	(2.5YR5/8)					
2100	Light reddish brown	5	10.0	0.1	0.3	2.47
1149	(2.5YR5/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Poor color at 2000°F. No effervescence when treated with HCl.**Potential uses:** Grade SW building brick; Type L floor brick.

*Munsell designation

INDIANA COUNTY Rayne Twp. Clymer quad.Sample number **56-B-6B**

Location: Quarry on the C. Ruffner property, located along the north side of Pa. Route 286, about 4.26 miles (6.9 km) west along Route 286 from Clymer.

Latitude: 40°39'52"N

Longitude: 79°05'13"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Grayish-olive to light-olive-gray, very thin to medium-bedded shales and silty shales occur below the sequence sampled as 56-B-6A. The amount of silt, especially in the lower portion of the sample, is noticeably greater than the amount contained in sample 56-B-6A.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 7 stratigraphic feet (2.1 m)

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	55.90	Quartz	18	Water of plasticity (%): 20.3
TiO ₂	0.83	Mica	66	Drying shrinkage (%): 2.5
Al ₂ O ₃	20.00	Kaolinite	0	Workability: Plastic
Fe ₂ O ₃	8.70	Chlorite-		Dry strength: Fair
MnO	0.175	vermiculite	11	Drying defects: None
MgO	2.11	Feldspar	5	pH: 7.4
CaO	0.61	Montmo-		
Na ₂ O	0.69	rillonite	0	
K ₂ O	3.40	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Mod. yellowish pink to	2	2.5	15.3	29.0	1.90
982	mod. orange (2.5YR7/6)					
1900	Moderate orange	3	5.0	11.2	23.0	2.05
1038	(2.5YR6/8)					
2000	Grayish reddish	5	10.0	4.4	10.1	2.31
1093	orange (2.5YR5/6)					
2100	Light reddish brown	6	12.5	0.1	0.2	2.39
1149	(2.5YR5/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

*Munsell designation

Remarks: Poor color at 2000°F. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type L floor brick.

INDIANA COUNTY Rayne Twp. Clymer quad.

Sample number **56-B-6C**

Location: Quarry on the C. Ruffner property, located along the north side of Pa. Route 286, about 4.26 miles (6.9 km) west along Route 286 from Clymer.

Latitude: 40°39'52"N

Longitude: 79°05'13"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Grayish-green interbedded silty shales and shaly siltstones occur beneath sequences collected in samples 56-B-6A and 56-B-6B. Beds are thin, ranging from about 1 to 3 inches (2.5 to 7.6 cm) in thickness. Fragments are commonly platy, chippy, or slabby.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 8 stratigraphic feet (2.4 m)

Chemical analysis: **Mineralogy (X-ray):** **Raw properties.**

	%		%	
SiO ₂	59.3	Quartz	24	Water of plasticity (%): 21.2
TiO ₂	0.92	Mica	52	Drying shrinkage (%): 2.5
Al ₂ O ₃	19.65	Kaolinite	7	Workability: Plastic
Fe ₂ O ₃	7.55	Chlorite-		Dry strength: Fair
MnO	0.063	vermiculite	12	Drying defects: None
MgO	2.08	Feldspar	5	pH: 7.4
CaO	0.28	Montmo-		
Na ₂ O	0.76	rillonite	0	
K ₂ O	3.28	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	2.5	16.4	30.2	1.84
982	(2.5YR7/8)					
1900	Moderate orange	2	5.0	13.7	26.8	1.96
1038	(2.5YR6/8)					
2000	Grayish reddish	4	7.5	6.6	14.5	2.20
1093	orange (2.5YR6/6)					

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2100	Grayish reddish	6	10.0	2.1	5.0	2.39
1149	orange (2.5YR5/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor color at 2000°F. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type H floor brick.

*Munsell designation

INDIANA COUNTY Cherryhill Twp. Clymer quad.

Sample number 56-B-7

Location: Exposure along the north side of Pa. Route 286, located about 10,500 feet (3200 m) by Route 286 west of Clymer.

Latitude: 40°39'49"N

Longitude: 79°02'37"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Dark-greenish-gray, very thinly bedded shaly siltstone beds are exposed for a stratigraphic interval estimated to be 30 feet (9 m). Beds are commonly less than 1/2 inch (1.3 cm) thick. Iron staining is present, especially along bedding planes and joints. The shaly siltstone breaks down into platy fragments having angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 12 stratigraphic feet (4 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	63.70	Quartz	26	Water of plasticity (%): 19.4
TiO ₂	0.97	Mica	50	Drying shrinkage (%): 5.0
Al ₂ O ₃	17.50	Kaolinite	14	Workability: Plastic
Fe ₂ O ₃	7.50	Chlorite-		Dry strength: Good
MnO	0.044	vermiculite	6	Drying defects: None
MgO	2.05	Feldspar	4	pH: 7.4
CaO	0.25	Montmo-		
Na ₂ O	0.40	rillonite	0	
K ₂ O	2.85	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Mod. yellowish pink to	2	5.0	15.5	29.1	1.88
982	mod. orange (5YR7/6)					
1900	Moderate orange	2	5.0	12.8	25.6	2.00
1038	(2.5YR6/8)					
2000	Brownish orange	3	5.0	9.3	19.5	2.11
1093	(2.5YR5/8)					
2100	Grayish reddish	5	7.5	5.5	12.4	2.24
1149	orange (10R5/6)					
2200	Grayish brown	7	10.0	0.4	0.9	2.37
1204	(5YR4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Good color at 2100°F. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates.

Munsell designation

INDIANA COUNTY Rayne Twp. Clymer quad.

Sample number 56-B-12

Location: Abandoned strip mine on the south side of Crooked Creek, about 5000 feet (1520 m) east of the Kintersburg Bridge.

Latitude: 40°42'48"N

Longitude: 79°03'50"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Dark-gray to grayish black, fissile shale occurs from 0 to 7 feet (0 to 2.1 m) above the Upper Freeport coal. Stratigraphically above the shale is at least 15 feet (5 m) of sandstone. The shale breaks down to form papery to platy fragments having angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample through the shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	54.10	Quartz	19	Water of plasticity (%): 18.3
TiO ₂	0.94	Mica	56	Drying shrinkage (%): 5.0
Al ₂ O ₃	18.25	Kaolinite	21	Workability: Plastic
Fe ₂ O ₃	7.86	Chlorite-		Dry strength: Fair
MnO	0.120	vermiculite	3	Drying defects: None
MgO	1.63	Feldspar	1	pH: 7.4
CaO	0.31	Montmo-		
Na ₂ O	0.20	rillonite	0	
K ₂ O	3.31	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light to mod. yellow-	2	5.0	16.8	31.1	1.85
982	ish pink (5YR8/4)					
1900	Mod. orange to light	3	5.0	14.1	27.6	1.95
1038	brown (5YR6/6)					
2000	Grayish reddish	4	7.5	7.9	17.4	2.19
1093	orange (2.5YR5/6)					
2100	Light reddish brown	5	10.0	3.8	8.9	2.30
1149	(2.5YR5/4)					
2200	--	--	--	--	--	--
1204						
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Positive

Remarks: Poor color at 2000°F. No effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	0.57	35.6	12.6	Mixed bloating and non-
1038				bloating.
2000	0.75	46.8	13.2	Mixed bloating and non-
1093				bloating.

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2100	0.55	34.3	22.2	Mixed bloating and non-bloating.
1149				
2200	0.66	41.2	16.5	Mixed bloating and non-bloating.
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type H floor brick; marginal raw material for lightweight aggregate (mixture of bloating and nonbloating material).

INDIANA COUNTY Center Twp. Brush Valley quad.

Sample number **56-D-10**

Location: Exposure along the west side of an unidentified heavy-duty road which trends northward from Pa. Route 56 about 13,000 feet (3960 m) north of the Route 56 intersection.

Latitude: 40°33'12"N

Longitude: 79°07'03"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium-dark-gray shales grading upward into shaly siltstones are exposed for a stratigraphic distance of 9 feet (2.7 m). Thicknesses of units range from thickly laminated to thinly bedded. Material breaks down to form platy to flaggy fragments having angular edges. The shales and siltstones weather to olive-gray colors, and brownish to yellowish iron stains are common along bedding and fractures.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate to slight

Sampled interval: Channel sample through 9 stratigraphic feet (2.7 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	61.00	Quartz	24	Water of plasticity (%): 21.9
TiO ₂	0.98	Mica	53	Drying shrinkage (%): 2.5
Al ₂ O ₃	18.05	Kaolinite	13	Workability: Plastic
Fe ₂ O ₃	6.13	Chlorite-		Dry strength: Fair
MnO	0.066	vermiculite	6	Drying defects: None
MgO	1.23	Feldspar	4	pH: 6.4
CaO	0.03	Montmo-		
Na ₂ O	0.16	rillonite	0	
K ₂ O	3.19	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color*</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Mod. yellowish pink to	2	5.0	20.6	35.8	1.73
982	mod. orange (5YR7/6)					
1900	Mod. yellowish pink to	3	5.0	17.5	31.9	1.82
1038	mod. orange (5YR7/6)					
2000	Grayish reddish	3	7.5	13.0	25.5	1.97
1093	orange (2.5YR6/6)					
2100	Grayish reddish	5	10.0	8.8	18.6	2.10
1149	orange (2.5YR5/6)					
2200	Light reddish brown	6	12.5	1.7	4.0	2.36
1204	(2.5YR5/4)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: Fair color at 2100°F. No effervescence when treated with HCl. Stratigraphically probably 100 to 150 feet (30 to 46 m) below the Upper Freeport coal.

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates.

*Munsell designation

INDIANA COUNTY Burrell Twp. Bolivar quad.Sample number **57-A-6**

Location: Exposure along the northwest side of U.S. Route 119, about 7500 feet (2290 m) southwest of the village of Black Lick.

Latitude: 40°27'08"N**Longitude:** 79°12'42"W**Geologic unit:** Casselman Formation, Conemaugh Group

Description: Interbedded grayish-red and grayish-green, calcareous shales are exposed for a stratigraphic interval of 8 feet (2.4 m). Shales break down to form hackly fragments.

Attitude of bedding: Essentially horizontal; dips about 2 degrees west-northwest

Weathering intensity: Slight to moderate

Sampled interval: Channel through 8 stratigraphic feet (2.4 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	52.60	Quartz	20	Water of plasticity (%): 18.9
TiO ₂	0.90	Mica	61	Drying shrinkage (%): 5.0
Al ₂ O ₃	18.85	Kaolinite	11	Workability: Plastic
Fe ₂ O ₃	8.60	Chlorite-		Dry strength: Good
MnO	0.111	vermiculite	3	Drying defects: None
MgO	2.18	Feldspar	5	pH: 8.3
CaO	1.53	Montmo-		
Na ₂ O	0.38	rillonite	0	
K ₂ O	3.38	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	12.8	25.6	2.00
982	(2.5YR6/8)					
1900	Moderate to strong	4	7.5	9.0	19.4	2.16
1038	orange (2.5YR6/10)					
2000	Grayish reddish	5	10.0	3.4	8.1	2.37
1093	orange (2.5YR5/6)					
2100	Light reddish brown	6	12.5	0.0	0.0	2.40
1149	(2.5YR5/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Poor color. Slight effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type M floor brick.

*Munsell designation

INDIANA COUNTY East Wheatfield Twp. New Florence quad.

Sample number 57-B-7

Location: Exposure along the northwest side of an unidentified heavy-duty road which is north of and parallels the Conemaugh River, about 4000 feet (1220 m) northwest of Seward.

Latitude: 40°25'13"N

Longitude: 79°01'52"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Dark-gray to light-olive-gray underclay is exposed for 5 feet (1.5 m) below a 3-inch (7.6-cm) bony coal seam, believed to represent the Upper Freeport coal. Above the coal is a 7- to 8-inch (17.8- to 20.3-cm) sandstone bed, which in turn is overlain by interbedded shales and sandstones. The underclay breaks into hackly fragments.

Attitude of bedding: Essentially horizontal; very slight dip to south

Weathering intensity: Slight to moderate

Sampled interval: Channel through 5 stratigraphic feet (1.5 m) of underclay

Chemical analysis:

%

SiO ₂	55.80
TiO ₂	1.14
Al ₂ O ₃	22.75
Fe ₂ O ₃	3.70
MnO	0.029
MgO	1.10
CaO	0.31
Na ₂ O	0.24
K ₂ O	3.47

Mineralogy (X-ray):

%

Quartz	25
Mica	52
Kaolinite	18
Chlorite-vermiculite	4
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 15.7
Drying shrinkage (%): 2.5
Workability: Short
Dry strength: Fair
Drying defects: None
pH: 6.9

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Pale orange yellow	3	5.0	12.7	24.8	1.95
982	(7.5YR8/4)					
1900	Light to mod. orange	4	5.0	10.3	21.0	2.04
1038	yellow (7.5YR8/6)					
2000	Mod. orange yellow to	5	7.5	7.1	15.4	2.19
1093	light yellowish brown					
	(7.5YR7/6)					
2100	Light yellowish	5	10.0	2.7	6.3	2.32
1149	brown (7.5YR7/4)					
2200	Light yellowish	6	10.0	2.8	6.4	2.30
1204	brown (10YR7/4)					
2300	Pale to grayish	7	10.0	0.3	0.6	2.31
1260	yellow (2.5Y8/2)					

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color at 2000°F. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick.

*Munsell designation

INDIANA COUNTY Montgomery Twp. Rochester Mills quad.Sample number **65-C-2A****Location:** Arcadia Company, Inc. strip mine, located about 3000 feet (910 m) northwest of the village of Gipsy.**Latitude:** 40°48'43"N**Longitude:** 78°53'12"W**Geologic unit:** Kittanning Formation, Allegheny Group**Description:** Medium-gray underclay to the Upper Kittanning coal is exposed in the floor of the strip pit. Some carbonaceous trash is present in the underclay.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Grab sample of upper 6 inches (15 cm) of the underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	60.60	Quartz	23	Water of plasticity (%): 19.7	
TiO ₂	1.07	Mica	54	Drying shrinkage (%): 2.5	
Al ₂ O ₃	21.75	Kaolinite	17	Workability: Plastic	
Fe ₂ O ₃	3.00	Chlorite-		Dry strength: Fair	
MnO	0.019	vermiculite	4	Drying defects: None	
MgO	1.05	Feldspar	2	pH: 7.8	
CaO	0.22	Montmo-			
Na ₂ O	0.15	rillonite	0		
K ₂ O	3.80	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light to mod. yellow-	3	2.5	11.6	22.9	1.97
982	ish pink (5YR8/4)					
1900	Light to mod. yellow-	3	5.0	8.3	17.5	2.10
1038	ish pink (5YR8/4)					
2000	Mod. yellowish pink to	4	7.5	4.5	10.3	2.26
1093	mod. orange (5YR7/6)					
2100	Light brown	4	10.0	0.0	0.0	2.41
1149	(7.5YR6/4)					
2200	Light yellowish	5	10.0	0.0	0.0	2.41
1204	brown (10YR6/4)					
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative

* Munsell designation

Remarks: Good color base for antique face brick.

Potential uses: Grade SW building brick; Type FBA facing brick.

INDIANA COUNTY Montgomery Twp. Rochester Mills quad.

Sample number 65-C-2B

Location: Arcadia Company, Inc. strip mine, located about 3000 feet (910 m) northwest of the village of Gipsy.

Latitude: 40°48'43"N

Longitude: 78°53'12"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Medium-dark-gray thin-bedded shaly siltstones are exposed above the Upper Kittanning coal. Iron staining is common along joints and bedding planes. The shaly siltstones break into fragments that are flaggy to slabby. The beds average 3 to 4 inches (7.6 to 10.2 cm) in thickness.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample from 0 to 10 feet (0 to 3 m) above the coal

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	61.10	Quartz	31	Water of plasticity (%): 18.3
TiO ₂	1.07	Mica	43	Drying shrinkage (%): 2.5
Al ₂ O ₃	16.10	Kaolinite	23	Workability: Plastic
Fe ₂ O ₃	7.50	Chlorite-		Dry strength: Fair
MnO	0.122	vermiculite	2	Drying defects: None
MgO	1.40	Feldspar	1	pH: 8.1
CaO	0.32	Montmo-		
Na ₂ O	0.16	rillonite	0	
K ₂ O	2.43	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate yellowish	3	2.5	17.1	30.8	1.80
982	pink (2.5YR7/4)					
1900	Light reddish brown	3	2.5	15.2	28.4	1.87
1038	(2.5YR6/4)					

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2000	Grayish reddish	3	5.0	11.3	22.6	2.00
1093	orange (2.5YR5/6)					
2100	Light reddish brown	4	7.5	6.5	14.2	2.18
1149	(10R5/4)					
2200	Grayish reddish	5	7.5	0.9	2.0	2.34
1204	brown (10R4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Good color at 2100°F. Slight effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.93	120.4	7.4	No expansion.
1038				
2000	1.48	92.4	12.2	Mixed bloating and non-
1093				bloating.
2100	0.92	57.4	18.6	Mixed bloating and non-
1149				bloating.
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates; marginal raw material for lightweight aggregate (mixture of bloating and nonbloating materials).

INDIANA COUNTY Canoe Twp. Rochester Mills quad.Sample number **65-C-3**

Location: Exposure along the east side of the Baltimore and Ohio Railroad tracks, about 2000 feet (610 m) north of the village of Roseboro.

Latitude: 40°52'05"N

Longitude: 78°58'16"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Dark-gray to olive-gray, silty shales grade stratigraphically upward into shaly siltstones in this exposure. The upper part of the section is calcareous. The beds are thickly laminated to thinly bedded, ranging from about 1/10 inch (0.3 cm) up to several inches in thickness. Fragments are platy to flaggy.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Channel sample through 10 stratigraphic feet (3 m)**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	57.50	Quartz	23	Water of plasticity (%): 15.2
TiO ₂	0.92	Mica	57	Drying shrinkage (%): 2.5
Al ₂ O ₃	19.10	Kaolinite	7	Workability: Short
Fe ₂ O ₃	8.08	Chlorite-		Dry strength: Poor
MnO	0.136	vermiculite	9	Drying defects: None
MgO	2.16	Feldspar	4	pH: 7.8
CaO	0.38	Montmo-		
Na ₂ O	0.50	rillonite	0	
K ₂ O	3.63	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Grayish reddish	3	2.5	17.6	31.7	1.80
982	orange (2.5YR6/6)					
1900	Grayish reddish	3	2.5	14.3	27.1	1.90
1038	orange (10R6/6)					
2000	Grayish reddish	3	5.0	11.8	23.5	2.00
1093	orange (10R5/6)					
2100	Moderate reddish	4	7.5	4.5	9.9	2.22
1149	brown (10R4/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Positive**Remarks:** Poor color. Some effervescence.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.92	119.8	8.2	No expansion.
1038				
2000	1.12	69.9	14.9	Good pore structure.
1093				
2100	0.74	46.2	17.4	Some large pores.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.**Potential uses:** Grade SW building brick; promising raw material for lightweight aggregate.**INDIANA COUNTY Banks Twp. Burnside quad.**

Sample number 65-D-2

Location: Arcadia Company, Inc. strip mine located about 2300 feet (700 m) southeast of the village of Smithport.**Latitude:** 40°49'57"N**Longitude:** 78°51'57"W**Geologic unit:** Kittanning Formation, Allegheny Group**Description:** Dark-gray to olive-black claystones containing a few interbeds of siltstone occur from 0 to 7 feet (0 to 2.1 m) above the rider coal to the Lower Kittanning. Beds are thin to thick, ranging from 1 inch (2.5 cm) up to 16 inches (41 cm) in thickness. Some iron staining is present along joints. Section becomes sandy above sampled interval.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Channel sample from 0 to 7 feet (0 to 2.1 m) above rider coal

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	62.80	Quartz	25	Water of plasticity (%): 19.9
TiO ₂	1.03	Mica	58	Drying shrinkage (%): 2.5
Al ₂ O ₃	18.75	Kaolinite	7	Workability: Plastic
Fe ₂ O ₃	7.44	Chlorite-		Dry strength: Fair
MnO	0.126	vermiculite	7	Drying defects: None
MgO	1.57	Feldspar	3	pH: 7.7
CaO	0.32	Montmo-		
Na ₂ O	0.25	rillonite	0	
K ₂ O	2.65	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate yellowish	3	2.5	17.7	31.8	1.80
982	pink (2.5YR7/4)					
1900	Grayish reddish	3	2.5	14.9	28.3	1.90
1038	orange (2.5YR6/6)					
2000	Grayish reddish	3	5.0	11.5	21.9	1.91
1093	orange (2.5YR5/6)					
2100	Moderate reddish	4	10.0	7.0	15.3	2.19
1149	brown (10R4/4)					
2200	Grayish reddish	5	10.0	4.4	9.8	2.24
1204	brown (10R4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Positive

Remarks: Fair color at 2100°F. No effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.92	119.8	7.5	No expansion.
1038				
2000	1.21	75.5	9.4	Mixed bloating and non-bloating.
1093				

Bloating tests (quick-firing):

Temp. (°F) (°C)	Bulk density		% Absorb.	Remarks
	(gm/cc)	(lb/ft ³)		
2100	1.01	63.0	10.9	Mixed bloating and non-bloating.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates; marginal raw material for lightweight aggregate (mixture of bloating and nonbloating material).

INDIANA COUNTY Greene Twp. Commodore quad.

Sample number **66-A-1**

Location: Leasure Coal Company stripping, located west of Little Mahoning Creek and about 13,000 feet (3960 m) northwest of the village of Commodore.

Latitude: 40°44'36"N

Longitude: 78°58'12"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Olive-gray underclay to the Lower Freeport coal is exposed in the floor of the strip pit. The underclay was not fully exposed; only the upper 6 inches (15 cm) was available for sampling. Plant debris was visible in the underclay. Sandstone units occur above the coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Grab sample of upper 6 inches (15 cm) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	65.10	Quartz	30	Water of plasticity (%): 19.1
TiO ₂	1.18	Mica	51	Drying shrinkage (%): 5.0
Al ₂ O ₃	21.35	Kaolinite	18	Workability: Plastic
Fe ₂ O ₃	2.18	Chlorite-		Dry strength: Good
MnO	0.022	vermiculite	0	Drying defects: None
MgO	0.84	Feldspar	1	pH: 7.5
CaO	0.21	Montmo-		
Na ₂ O	0.14	rillonite	0	
K ₂ O	2.65	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i> *	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Pale yellowish pink	3	5.0	13.2	25.5	1.93
982	(7.5YR9/2)					
1900	Yellowish white	3	5.0	10.8	21.5	1.99
1038	(10YR9/2)					
2000	Yellowish white	4	7.5	7.9	16.7	2.11
1093	(2.5Y9/2)					
2100	Pale to grayish	5	7.5	3.2	7.2	2.25
1149	yellow (2.5Y8/4)					
2200	Grayish yellow to yel-	5	10.0	1.2	2.8	2.29
1204	lowish gray (2.5Y8/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Good color at 2000°F. A stoneware-type clay of good quality.
No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing
tile; stoneware.

*Munsell designation

INDIANA COUNTY Buffington Twp. Strongstown quad.

Sample number 66-C-2

Location: Exposure at the fork of a medium-duty road and a light-duty road,
about 6500 feet (1980 m) southwest of Red Mill.

Latitude: 40°30'20"N

Longitude: 78°55'20"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-gray to dark-greenish-gray, thickly laminated to thinly
bedded, shaly siltstones are exposed for a distance of 7.5 feet
(2.3 m). Beds range in thickness from 1/4 to 1-1/2 inches (0.6 to
3.8 cm). Yellow-orange-brown iron staining is moderate to severe
along fractures and bedding planes. The siltstones break down to
form platy or flaggy fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate to slight

Sampled interval: Channel sample through 7.5 feet (2.3 m)

Chemical analysis:

	%
SiO ₂	51.00
TiO ₂	0.85
Al ₂ O ₃	20.45
Fe ₂ O ₃	8.58
MnO	0.093
MgO	2.15
CaO	0.22
Na ₂ O	0.48
K ₂ O	3.71

Mineralogy (X-ray):

	%
Quartz	15
Mica	64
Kaolinite	9
Chlorite-vermiculite	9
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 23.6
 Drying shrinkage (%): 2.5
 Workability: Plastic
 Dry strength: Fair
 Drying defects: None
 pH: 6.0

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Mod. yellowish pink to	3	2.5	21.7	36.7	1.69
982	mod. orange (2.5YR7/6)					
1900	Moderate orange	3	2.5	15.9	29.2	1.83
1038	(2.5YR6/8)					
2000	Brownish orange	4	7.5	12.0	24.0	2.00
1093	(2.5YR5/8)					
2100	Moderate reddish	5	10.0	4.7	10.5	2.24
1149	brown (10R4/4)					
2200	Grayish reddish	5	12.5	1.1	2.6	2.31
1204	brown (10R4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Positive**Remarks:** Good color at 2100°F. No effervescence when treated with HCl.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.97	122.9	6.6	No expansion.
1038				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2000	1.44	89.9	8.4	Slight expansion.
1093				
2100	1.00	62.4	12.7	Good pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; stoneware; promising raw material for lightweight aggregate.

LAWRENCE COUNTY Mahoning Twp. Edinburg quad.

Sample number **4-C-1A**

Location: Coal stripping located south of Youngstown Road, about 5700 feet (1740 m) northeast of the village of Robinson.

Latitude: 41°02'20"N

Longitude: 80°28'45"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Dark-gray, thin-bedded shales occur stratigraphically above what is believed to be the Brookville coal. The shales measure 15 stratigraphic feet (5 m) in thickness and the upper limit is in contact with a 3-foot (0.9-m) sandstone bed. Yellow-brown iron staining is present at places in the shale. The shales are noncalcareous.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through lower 10 feet (3 m) of shale

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	<i>%</i>		<i>%</i>	
SiO ₂	60.30	Quartz	25	Water of plasticity (%): 21.1
TiO ₂	1.04	Mica	57	Drying shrinkage (%): 2.5
Al ₂ O ₃	18.50	Kaolinite	11	Workability: Plastic
Fe ₂ O ₃	6.04	Chlorite-		Dry strength: Good
MnO	0.05	vermiculite	5	Drying defects: None
MgO	1.36	Feldspar	2	pH: 4.5

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	0.16	Montmo-	
Na ₂ O	0.17	rillonite	0
K ₂ O	3.17	Calcite	0

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Mod. yellowish pink to	2	5.0	21.5	35.9	1.67
982	mod. orange (5YR7/6)					
1900	Moderate orange to	2	5.0	19.5	33.8	1.74
1038	light brown (5YR6/6)					
2000	Light brown to brown-	3	7.5	16.3	29.8	1.83
1093	ish orange (5YR5/6)					
2100	Grayish reddish	3	7.5	14.2	26.7	1.88
1149	orange (2.5YR5/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: No effervescence when treated with HCl. Abrupt vitrification (2100-2200°F). Too soft.

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

LAWRENCE COUNTY Mahoning Twp. Edinburg quad.

Sample number 4-C-1B

Location: Coal stripping located south of the Youngstown Road, about 5700 feet (1740 m) northeast of the village of Robinson.

Latitude: 41°02'20"N

Longitude: 80°28'45"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Dark- to medium-gray claystones occur above the 3-foot (0.9-m) sandstone described in sample 4-C-1A. The exposure of claystone suitable for sampling was limited to 49 inches (124 cm), but an extension of the claystone stratigraphically upward is probable. A slight amount of iron staining is present.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 49 inches (124 cm) of claystone

Chemical analysis:

	%
SiO ₂	60.10
TiO ₂	1.38
Al ₂ O ₃	22.30
Fe ₂ O ₃	1.85
MnO	0.013
MgO	0.77
CaO	0.13
Na ₂ O	0.18
K ₂ O	3.52

Mineralogy (X-ray):

	%
Quartz	23
Mica	51
Kaolinite	23
Chlorite-vermiculite	0
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 21.8
 Drying shrinkage (%): 2.5
 Workability: Plastic
 Dry strength: Good
 Drying defects: None
 pH: 7.0

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Yellowish white	3	5.0	18.7	32.5	1.73
982	(10YR9/2)					
1900	Yellowish white	3	7.5	15.5	28.6	1.84
1038	(10YR9/2)					
2000	Yellowish white	3	10.0	13.1	25.2	1.92
1093	(10YR9/2)					
2100	Yellowish white	4	10.0	10.4	20.9	2.01
1149	(2.5Y9/2)					
2200	Yellowish gray	7	12.5	2.1	4.7	2.28
1204	(2.5Y7/2)					
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: No effervescence when treated with dilute HCl. Abrupt vitrification (2100-2200°F).

Potential uses: Type FBS facing brick.

*Munsell designation

LAWRENCE COUNTY Mahoning Twp. Edinburg quad.

Sample number **4-C-2A**

Location: Strip pit operated by the C. D. Ambrosia Trucking Company, located about 9000 feet (2740 m) north-northwest of North Edinburg.

Latitude: 41°02'40"N

Longitude: 80°27'02"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Medium- to dark-gray, noncalcareous claystones, interbedded with a few 2- to 3-inch- (5.1- to 7.6-m-) thick siltstone beds occur above 8 inches (20 cm) of bony coal. The coal is believed to represent the Clarion seam. The claystones break down into hackly or rubbly fragments having angular edges. The sampled interval is from 0 to 10 feet (0 to 3 m) above the coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample through 10 stratigraphic feet (3 m) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	53.70	Quartz	15	Water of plasticity (%):	22.5
TiO ₂	0.95	Mica	55	Drying shrinkage (%):	5.0
Al ₂ O ₃	22.40	Kaolinite	26	Workability:	Plastic
Fe ₂ O ₃	7.00	Chlorite-		Dry strength:	Good
MnO	0.040	vermiculite	0	Drying defects:	None
MgO	1.04	Feldspar	4	pH:	8.0
CaO	0.52	Montmo-			
Na ₂ O	0.21	rillonite	0		
K ₂ O	3.77	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Yellowish white	3	5.0	15.2	28.4	1.86
982	(10YR9/2)					
1900	Pale orange yellow	5	7.5	10.3	20.8	2.03
1038	(7.5YR8/4)					
2000	Light yellowish	6	10.0	8.1	17.2	2.12
1093	brown (7.5YR7/4)					
2100	Light brown	7	10.0	4.7	10.5	2.24
1149	(7.5YR6/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: No effervescence when treated with dilute HCl. Abrupt vitrification (2100-2200°F).

Potential uses: Type FBS facing brick.

*Munsell designation

LAWRENCE COUNTY Mahoning Twp. Edinburg quad.Sample number **4-C-2B**

Location: Strip pit operated by the C. D. Ambrosia Trucking Company, located about 9000 feet (2740 m) north-northwest of North Edinburg.

Latitude: 41°02'40"N**Longitude:** 80°27'02"W**Geologic unit:** Clarion Formation, Allegheny Group

Description: Medium- to dark-gray, noncalcareous claystones occur from 3-1/2 to 13-1/2 feet (1.1 to 4.1 m) below what is believed to be the Clarion coal. Some siderite nodules are present in the sampled interval. The claystones break down into hackly to platy fragments having angular edges. A massive sandstone bed separates the claystone from the 8-inch (20-cm) Clarion coal.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight

Sampled interval: Channel sample through 10 stratigraphic feet (3 m) of claystone

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	60.70	Quartz	30	Water of plasticity (%): 22.8
TiO ₂	1.025	Mica	42	Drying shrinkage (%): 7.5
Al ₂ O ₃	17.95	Kaolinite	23	Workability: Plastic
Fe ₂ O ₃	6.80	Chlorite-		Dry strength: Good
MnO	0.073	vermiculite	4	Drying defects: None
MgO	1.53	Feldspar	1	pH: 6.6
CaO	0.22	Montmo-		
Na ₂ O	0.15	rillonite	0	
K ₂ O	3.12	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate yellowish	2	7.5	18.6	32.8	1.76
982	pink (5YR7/4)					
1900	Grayish reddish	3	10.0	15.6	29.1	1.86
1038	orange (2.5YR6/6)					
2000	Light reddish brown	3	10.0	13.3	25.9	1.94
1093	(2.5YR6/4)					
2100	Light reddish brown	4	10.0	10.1	20.9	2.05
1149	(2.5YR5/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative

*Munsell designation

Remarks: No effervescence when treated with HCl. Abrupt vitrification (2100-2200°F). Too soft. Scumming.

Potential uses: Not suitable for use in vitreous clay products.

LAWRENCE COUNTY Mahoning Twp. Edinburg quad.

Sample number **4-C-2C**

Location: Strip pit operated by the C. D. Ambrosia Trucking Company, located about 9000 feet (2740 m) north-northwest of North Edinburg.

Latitude: 41°02'40"N

Longitude: 80°27'02"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Dark-gray noncalcareous claystones occur from 0 to 9 feet (0 to 2.7 m) above the Brookville(?) coal. Some siderite nodules are present in the sampled interval. The claystones break down into hackly to platy fragments having angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel through 9 stratigraphic feet (2.7 m) of claystones

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	57.40	Quartz	23	Water of plasticity (%): 20.9	
TiO ₂	0.96	Mica	48	Drying shrinkage (%): 5.0	
Al ₂ O ₃	19.00	Kaolinite	25	Workability: Plastic	
Fe ₂ O ₃	7.20	Chlorite-		Dry strength: Good	
MnO	0.086	vermiculite	3	Drying defects: None	
MgO	1.85	Feldspar	1	pH: 8.1	
CaO	0.32	Montmo-			
Na ₂ O	0.20	rillonite	0		
K ₂ O	3.58	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate yellowish	2	5.0	18.5	32.9	1.78
982	pink (5YR7/4)					
1900	Moderate orange to	3	7.5	15.2	28.7	1.89
1038	light brown (5YR6/6)					
2000	Grayish reddish	3	10.0	11.8	23.8	2.02
1093	orange (2.5YR5/6)					

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2100 1149	Strong brown (2.5YR4/6)	3	10.0	8.4	17.9	2.13
2200 1204	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND **Bloating test:** Positive

Remarks: Abrupt vitrification (2100-2200°F). Too soft. Scumming.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Platy

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800 982	2.22	138.5	6.9	No expansion.
1900 1038	2.07	129.2	8.5	No expansion.
2000 1093	1.84	114.8	10.0	No expansion.
2100 1149	1.55	96.7	11.9	Partial expansion.
2200 1204	0.94	58.7	16.1	Overfired.
2300 1260	--	--	--	--

Potential uses: Marginal raw material for lightweight aggregate. Short range.

LAWRENCE COUNTY Union Twp. Edinburg quad.

Sample number 4-C-3A

Location: Roadcut exposure on the west side of U.S. Route 422, about 3500 feet (1070 m) south of the U.S. Route 224 overpass (Grant Street exit).

Latitude: 41°00'06"N

Longitude: 80°23'43"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Light- to medium-gray underclay, 6 feet (1.8 m) thick, occurs beneath a 21-1/2-inch (54.6-cm) coal which is believed to represent the Middle Kittanning. The underclay is relatively soft and breaks down into hackly fragments having angular edges. Iron staining is slight throughout, but more noticeable in the lower 2 feet (0.6 m) of the sampled interval.

Attitude of bedding: N10W, 14W

Weathering intensity: Slight to moderate

Sampled interval: Channel through 6 stratigraphic feet (1.8 m) of underclay

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	59.20	Quartz	21	Water of plasticity (%): 18.5
TiO ₂	1.48	Mica	38	Drying shrinkage (%): 5.0
Al ₂ O ₃	23.70	Kaolinite	40	Workability: Plastic
Fe ₂ O ₃	1.56	Chlorite-		Dry strength: Good
MnO	0.012	vermiculite	0	Drying defects: None
MgO	0.58	Feldspar	1	pH: 5.0
CaO	0.11	Montmo-		
Na ₂ O	0.17	rillonite	0	
K ₂ O	2.60	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Yellowish white	3	5.0	15.5	28.6	1.84
982	(10YR9/2)					
1900	Yellowish white	3	5.0	14.0	26.6	1.89
1038	(10YR9/2)					
2000	Yellowish white	3	5.0	11.7	23.2	1.99
1093	(10YR9/2)					
2100	Yellowish white	4	7.5	10.6	21.3	2.01
1149	(2.5Y9/2)					
2200	Yellowish gray	5	10.0	2.6	5.9	2.27
1204	(2.5Y8/2)					
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: No effervescence when treated with HCl. Aprupt vitrification (2100-2200°F).

Potential uses: Type FBS facing brick.

*Munsell designation

LAWRENCE COUNTY Union Twp. Edinburg quad.Sample number **4-C-3B**

Location: Roadcut exposure along the west side of U.S. Route 422, about 3500 feet (1070 m) south of the U.S. Route 224 overpass (Grant Street exit).

Latitude: 41°00'06"N

Longitude: 80°23'43"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Brownish-black to olive-black, calcareous claystones occur stratigraphically below the underclay to the Middle Kittanning coal (refer to sample 4-C-3A). The claystone interval measures 6 feet (1.8 m) and is underlain by 53 inches (135 cm) of sandstone. The claystone breaks down into hackly fragments having angular edges. Iron staining is not noticeable.

Attitude of bedding: N10W, 14W**Weathering intensity:** Slight to moderate

Sampled interval: Channel sample through 6 stratigraphic feet (1.8 m) of claystone

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	>70.00	Quartz	35	Water of plasticity (%): 17.6
TiO ₂	1.17	Mica	37	Drying shrinkage (%): 5.0
Al ₂ O ₃	18.50	Kaolinite	25	Workability: Plastic
Fe ₂ O ₃	1.30	Chlorite-		Dry strength: Good
MnO	0.007	vermiculite	0	Drying defects: None
MgO	0.56	Feldspar	3	pH: 8.2
CaO	0.24	Montmo-		
Na ₂ O	0.16	rillonite	0	
K ₂ O	2.22	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Yellowish white	2	5.0	15.3	28.0	1.84
982	(10YR9/1)					
1900	Yellowish white	3	5.0	14.5	27.0	1.87
1038	(10YR9/2)					
2000	Yellowish gray	4	5.0	12.7	24.5	1.92
1093	(10YR8/2)					
2100	Yellowish white	5	5.0	11.6	22.8	1.97
1149	(2.5Y9/2)					
2200	Yellowish gray	6	10.0	3.4	7.5	2.21
1204	(2.5Y7/2)					

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2300 1260	--	--	Melted	--	--	--

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: No effervescence when treated with HCl. Abrupt vitrification (2100-2200°F).

Potential uses: Type FBS facing brick.

*Munsell designation

LAWRENCE COUNTY Union Twp. Edinburg quad.

Sample number 4-C-3C

Location: Roadcut exposure along the west side of U.S. Route 422, about 3500 feet (1070 m) south of the U.S. Route 224 overpass (Grant Street exit).

Latitude: 41°00'06"N

Longitude: 80°23'43"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Greenish-gray noncalcareous underclay to the Lower Kittanning(?) coal is exposed in the roadcut. The soft underclay breaks easily into hackly fragments which range in size from about 1/4 inch (0.6 cm) to several inches. Iron staining is present along fractures. The Lower Kittanning coal measures 14 to 15 inches (36 to 38 cm) in thickness.

Attitude of bedding: N10W, 14W

Weathering intensity: Slight

Sampled interval: Channel sample through 20 inches (51 cm) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	68.70	Quartz	43	Water of plasticity (%): 18.8
TiO ₂	1.00	Mica	47	Drying shrinkage (%): 2.5
Al ₂ O ₃	16.45	Kaolinite	9	Workability: Plastic
Fe ₂ O ₃	2.10	Chlorite-		Dry strength: Good
MnO	0.002	vermiculite	0	Drying defects: None
MgO	0.77	Feldspar	1	pH: 6.5
CaO	0.19	Montmo-		
Na ₂ O	0.13	rillonite	0	
K ₂ O	3.10	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Yellowish white	3	2.5	13.6	25.9	1.90
982	(10YR9/2)					
1900	Pale orange yellow	4	5.0	12.1	23.8	1.96
1038	(10YR8/4)					
2000	Pale orange yellow	4	5.0	9.5	19.5	2.05
1093	(10YR8/4)					
2100	Light yellowish	5	5.0	8.3	17.4	2.09
1149	brown (10YR7/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: No effervescence when treated with HCl. Abrupt vitrification (2100-2200°F).

Potential uses: Type FBS facing brick.

*Munsell designation

LAWRENCE COUNTY Union Twp. Edinburg quad.

Sample number 4-C-3D

Location: Roadcut exposure along the west side of U.S. Route 422, about 3500 feet (1070 m) south of the U.S. Route 224 overpass (Grant Street exit).

Latitude: 41°00'06"N

Longitude: 80°23'43"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Medium-dark-gray to black, interbedded fissile shales and thin-bedded silty shales occur for a stratigraphic interval of 8 feet (2.4 m) above the Vanport limestone. Siderite nodules, some greater than 12 inches (30 cm) in long dimension, are present, especially in the lower portion of the sampled interval. Red-brown to brown-tan iron staining is common along fractures. Shale breaks down to platy fragments ranging in size from less than 1/2 inch (1.3 cm) to several inches.

Attitude of bedding: N10W, 14W

Weathering intensity: Slight to moderate

Sampled interval: Channel through 8 stratigraphic feet (2.4 m) of shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	66.30	Quartz	32	Water of plasticity (%): 21.0	
TiO ₂	0.79	Mica	54	Drying shrinkage (%): 5.0	
Al ₂ O ₃	14.40	Kaolinite	9	Workability: Plastic	
Fe ₂ O ₃	6.45	Chlorite-		Dry strength: Fair	
MnO	0.034	vermiculite	2	Drying defects: None	
MgO	1.24	Feldspar	3	pH: 4.8	
CaO	0.35	Montmo-			
Na ₂ O	0.54	rillonite	0		
K ₂ O	2.90	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	17.2	30.8	1.79
982	(5YR7/6)					
1900	Moderate orange	3	5.0	15.1	28.1	1.86
1038	(5YR6/6)					
2000	Grayish reddish	4	10.0	12.0	23.4	1.96
1093	orange (2.5YR5/6)					
2100	Moderate reddish	4	10.0	9.8	19.9	2.03
1149	brown (2.5YR4/4)					
2200	--	----	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: No effervescence when treated with HCl. Abrupt vitrification (2100-2200°F).

Potential uses: Grade SW building brick.

*Munsell designation

LAWRENCE COUNTY Union Twp. Edinburg quad.

Sample number **4-C-3E**

Location: Roadcut exposure along the west side of U.S. Route 422, about 3500 feet (1070 m) south of the U.S. Route 224 overpass (Grant Street exit).

Latitude: 41°00'06"N

Longitude: 80°23'43"W

Geologic unit: Clarion Formation; Allegheny Group

Description: Medium- to dark-gray underclay occurs under a 4- to 5-inch (10- to 13-cm) coal believed to represent the Scrubgrass coal. Iron staining is intense; dark-reddish-brown discoloration permeates the underclay. The underclay measures 38 inches (97 cm) in thickness, and breaks down into hackly fragments.

Attitude of bedding: N10W, 14W

Weathering intensity: Moderate

Sampled interval: Channel through underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	66.30	Quartz	30	Water of plasticity (%): 19.9
TiO ₂	1.00	Mica	55	Drying shrinkage (%): 2.5
Al ₂ O ₃	17.30	Kaolinite	13	Workability: Plastic
Fe ₂ O ₃	5.00	Chlorite-		Dry strength: Good
MnO	0.036	vermiculite	1	Drying defects: None
MgO	1.16	Feldspar	1	pH: 4.7
CaO	0.12	Montmo-		
Na ₂ O	0.16	rillonite	0	
K ₂ O	3.10	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate yellowish	3	2.5	15.2	28.3	1.86
982	pink (5YR8/4)					
1900	Moderate yellowish	3	5.0	12.5	24.3	1.95
1038	pink (5YR7/4)					
2000	Moderate orange	5	10.0	8.9	18.5	2.08
1093	(5YR6/6)					
2100	Brownish orange	5	10.0	6.6	14.2	2.16
1149	(5YR5/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Scumming. Abrupt vitrification (2100-2200°F).

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

LAWRENCE COUNTY Union Twp. Edinburg quad.Sample number **4-C-3F****Location:** Roadcut exposure along the west side of U.S. Route 422, about 3500 feet (1070 m) south of the U.S. Route 224 overpass (Grant Street exit).**Latitude:** 41°00'06"N**Longitude:** 80°23'43"W**Geologic unit:** Clarion Formation, Allegheny Group**Description:** Medium-gray underclay occurs beneath a 7-inch (18-cm) coal believed to be the Clarion coal. Iron staining, brown to moderate yellow brown in color, is common along fractures in the underclay. The underclay breaks down into hackly fragments.**Attitude of bedding:** N10W, 14W**Weathering intensity:** Slight to moderate**Sampled interval:** Channel through 34 inches (86 cm) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	65.80	Quartz	34	Water of plasticity (%)	21.9
TiO ₂	1.12	Mica	41	Drying shrinkage (%)	7.5
Al ₂ O ₃	18.65	Kaolinite	18	Workability:	Plastic
Fe ₂ O ₃	3.82	Chlorite-		Dry strength:	Good
MnO	0.024	vermiculite	2	Drying defects:	None
MgO	1.22	Feldspar	5	pH:	4.7
CaO	0.05	Montmo-			
Na ₂ O	0.16	rillonite	0		
K ₂ O	3.52	Calcite	0		

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Pale orange yellow	2	7.5	16.4	29.6	1.80
982	(7.5YR8/4)					
1900	Moderate orange	3	7.5	14.0	26.5	1.89
1038	(5YR7/6)					
2000	Moderate orange	4	10.0	10.9	22.0	2.01
1093	(5YR6/6)					
2100	Moderate orange	4	10.0	8.9	18.4	2.07
1149	(5YR6/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative

*Munsell designation

Remarks: Abrupt vitrification (2100-2200°F).

Potential uses: Grade SW building brick.

LAWRENCE COUNTY Hickory Twp. New Castle North quad.

Sample number **4-D-4A**

Location: Inactive clay stripping owned by the Fenati Brick Company, Inc., located about 1 mile (1.6 km) east of New Castle.

Latitude: 41°00'23"N

Longitude: 80°17'51"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Pale-olive, light-olive-brown, and greenish-gray silty claystones are exposed in the upper 6 feet (1.8 m) of the strip pit. Partings and/or bedding in the claystones are spaced from 1 to 3 inches (2.5 to 7.6 cm) apart. Iron staining in general is slight, but locally it is concentrated. The claystone breaks into platy to slabby fragments.

Attitude of bedding: Horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 6 stratigraphic feet (1.8 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	60.20	Quartz	25	Water of plasticity (%): 21.6
TiO ₂	1.07	Mica	55	Drying shrinkage (%): 5.0
Al ₂ O ₃	17.10	Kaolinite	11	Workability: Plastic
Fe ₂ O ₃	8.55	Chlorite-		Dry strength: Good
MnO	0.105	vermiculite	3	Drying defects: None
MgO	1.16	Feldspar	3	pH: 7.5
CaO	0.24	Montmo-		
Na ₂ O	0.17	rillonite	3	
K ₂ O	3.30	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	17.5	31.2	1.78
982	(5YR7/6)					
1900	Moderate orange	3	5.0	14.2	26.8	1.90
1038	(5YR6/8)					

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2000	Brownish orange	4	10.0	10.1	20.6	2.03
1093	(2.5YR5/8)					
2100	Strong brown	5	10.0	8.3	17.3	2.10
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F).

Potential uses: Type FBS facing brick.

*Munsell designation

LAWRENCE COUNTY Hickory Twp. New Castle North quad.

Sample number **4-D-4B**

Location: Inactive clay stripping owned by the Fenati Brick Company, Inc., located about 1 mile (1.6 km) east of New Castle.

Latitude: 41°00'23"N

Longitude: 80°17'51"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Dark-greenish-gray to light-olive-gray, silty claystones are beneath sample 4-D-4A. A slight amount of iron staining is evident. The claystones break into chippy to slabby fragments having angular edges. The claystones are stratigraphically probably somewhere between the Middle and Lower Kittanning coals.

Attitude of bedding: Horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 7 stratigraphic feet (2.1 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	61.20	Quartz	30	Water of plasticity (%): 19.7
TiO ₂	1.08	Mica	56	Drying shrinkage (%): 5.0
Al ₂ O ₃	17.80	Kaolinite	9	Workability: Plastic
Fe ₂ O ₃	5.52	Chlorite-		Dry strength: Good
MnO	0.036	vermiculite	4	Drying defects: None
MgO	1.47	Feldspar	1	pH: 7.7

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	0.29	Montmo-	
Na ₂ O	0.22	rillonite	0
K ₂ O	3.42	Calcite	0

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	16.5	29.9	1.82
982	(5YR7/6)					
1900	Moderate orange	3	5.0	13.7	26.2	1.92
1038	(5YR6/6)					
2000	Grayish reddish	4	10.0	9.6	19.9	2.08
1093	orange (2.5YR5/6)					
2100	Strong brown	5	10.0	7.6	16.3	2.15
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F).

Potential uses: Type FBS facing brick.

*Munsell designation

LAWRENCE COUNTY North Beaver Twp. Bessemer quad.

Sample number **5-A-20**

Location: Strip pit operated by Ralph Veon, located about 3500 feet (1070 m) due east of the village of Derringer Corners.

Latitude: 40°55'35"N

Longitude: 80°27'05"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Gray underclay to the Lower Kittanning coal is exposed for its full stratigraphic thickness of 5 feet (1.5 m) in the stripping. Upper 1 foot (0.3 m) of the underclay contains plant debris. Streaks of coaly material are evident 30 inches (76 cm) below the upper contact. The underclay breaks into small hackly fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Channel through 5 feet (1.5 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	62.30	Quartz	36	Water of plasticity (%): 21.7
TiO ₂	1.80	Mica	29	Drying shrinkage (%): 5.0
Al ₂ O ₃	21.40	Kaolinite	33	Workability: Plastic
Fe ₂ O ₃	1.40	Chlorite-		Dry strength: Good
MnO	0.004	vermiculite	0	Drying defects: None
MgO	0.40	Feldspar	1	pH: 4.0
CaO	0.25	Montmo-		
Na ₂ O	0.08	rillonite	0	
K ₂ O	1.03	Calcite	1	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Cream	3	5.0	16.9	31.1	1.84
982						
1900	Cream	3	7.5	14.2	27.1	1.91
1038						
2000	Cream	3	10.0	12.4	24.2	1.93
1093						
2100	Cream	4	10.0	12.2	23.9	1.98
1149						
2200	Ivory	4	10.0	9.3	19.7	2.12
1204						
2300	Ivory	5	12.5	7.5	15.6	2.09
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: A stoneware-type clay of excellent quality. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; stoneware.

LAWRENCE COUNTY Little Beaver Twp. Bessemer quad.

Sample number **5-A-21**

Location: Strip pit operated by Ralph A. Veon, located about 12,500 feet (3810 m) west-southwest of the village of Mount Air.

Latitude: 40°53'49"N

Longitude: 80°29'17"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Light-gray silty underclay occurs from 36 to 72 inches (91 to 183 cm) below the base of the Lower Kittanning coal. Yellow iron staining is present along slickensided surfaces and fractures. The underclay breaks into cone-shaped and lens-like fragments. Some plant debris is scattered throughout interval. Sample 5-A-22 lies stratigraphically above this sample.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel through lower 3 feet (0.9 m) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	65.80	Quartz	49	Water of plasticity (%): 16.5
TiO ₂	1.47	Mica	34	Drying shrinkage (%): 2.5
Al ₂ O ₃	21.95	Kaolinite	16	Workability: Plastic
Fe ₂ O ₃	1.39	Chlorite-		Dry strength: Good
MnO	0.008	vermiculite	0	Drying defects: None
MgO	0.48	Feldspar	1	pH: 4.1
CaO	0.20	Montmo-		
Na ₂ O	0.14	rillonite	0	
K ₂ O	1.80	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	5.0	15.2	28.2	1.86
982						
1900	Cream	3	5.0	15.0	28.0	1.87
1038						
2000	Cream	3	5.0	14.1	26.7	1.89
1093						
2100	Cream	4	5.0	12.5	24.7	1.97
1149						
2200	Ivory	4	7.5	10.7	22.2	2.08
1204						
2300	Ivory	5	10.0	7.4	15.5	2.08
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: A stoneware-type clay of excellent quality.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; stoneware.

LAWRENCE COUNTY Little Beaver Twp. Bessemer quad.Sample number **5-A-22****Location:** Strip pit operated by Ralph A. Veon, located about 12,500 feet (3810 m) west-southwest of the village of Mount Air.**Latitude:** 40°53'49"N**Longitude:** 80°29'17"W**Geologic unit:** Clarion Formation, Allegheny Group**Description:** Light- to medium-gray, plastic underclay occurs from 0 to 36 inches (0 to 91 cm) below the Lower Kittanning coal. Iron staining is present along slickensided surfaces. Breaks into small lens-shaped fragments which are commonly smaller than those formed from the underclay in sample 5-A-21.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Unweathered**Sampled interval:** Channel through upper 3 feet (0.9 m) of underclay**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	64.20	Quartz	25	Water of plasticity (%): 23.0
TiO ₂	1.95	Mica	14	Drying shrinkage (%): 5.0
Al ₂ O ₃	26.45	Kaolinite	46	Workability: Plastic
Fe ₂ O ₃	1.33	Chlorite-		Dry strength: Good
MnO	0.003	vermiculite	0	Drying defects: None
MgO	0.51	Feldspar	1	pH: 3.6
CaO	0.30	Montmo-		
Na ₂ O	0.10	rillonite	14	
K ₂ O	1.15	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Cream	3	10.0	17.3	31.0	1.79
982						
1900	Cream	3	10.0	13.8	26.1	1.88
1038						
2000	Cream	4	10.0	13.7	26.1	1.90
1093						
2100	Cream	4	12.5	12.7	25.0	1.97
1149						
2200	Ivory	5	12.5	11.0	23.0	2.08
1204						
2300	Ivory	6	15.0	8.9	18.0	2.03
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: A stoneware-type clay of excellent quality. Clay is used for making nozzles.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; stoneware.

LAWRENCE COUNTY Little Beaver Twp. Bessemer quad.

Sample number **5-A-23**

Location: Strip pit operated by Ralph A. Veon, located about 12,500 feet (3810 m) west-southwest of the village of Mount Air.

Latitude: 40°53'49"N

Longitude: 80°29'17"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Light- to medium-gray underclay to the Lower Kittanning coal is exposed for a stratigraphic thickness of 6 feet (1.8 m). This sample represents the combined intervals sampled as 5-A-21 and 5-A-22.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Channel through 6 feet (1.8 m) of underclay

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	66.90	Quartz	34	Water of plasticity (%): 22.0
TiO ₂	1.30	Mica	34	Drying shrinkage (%): 5.0
Al ₂ O ₃	20.30	Kaolinite	30	Workability: Plastic
Fe ₂ O ₃	1.44	Chlorite-		Dry strength: Good
MnO	0.008	vermiculite	0	Drying defects: None
MgO	0.58	Feldspar	2	pH: 5.2
CaO	0.28	Montmo-		
Na ₂ O	0.17	rillonite	0	
K ₂ O	2.27	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	5.0	16.2	29.4	1.81
982						
1900	Cream	3	5.0	13.9	26.3	1.89
1038						
2000	Cream	3	5.0	13.4	25.6	1.91
1093						
2100	Cream	3	5.0	12.9	25.0	1.94
1149						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2200 1204	Ivory	3	5.0	10.8	22.1	2.04
2300 1260	Ivory	4	5.0	7.4	15.5	2.10

Pyrometric cone equivalent: ND Bloating test: Negative

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; stoneware.

LAWRENCE COUNTY Little Beaver Twp. Bessemer quad.

Sample number 5-A-24

Location: Strip pit operated by Ralph A. Veon, located about 12,500 feet (3810 m) west-southwest of the village of Mount Air.

Latitude: 40°53'49"N

Longitude: 80°29'17"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium-gray to slightly olive, fissile to thin-bedded shale occurs stratigraphically above the Lower Kittanning coal. The shale contains minor amounts of silt locally. A zone of limy nodules and limy siltstone lenses occurs from 2 to 4 feet (0.6 to 1.2 m) above the base. The upper 3 feet (0.9 m) of the sampled interval contains abundant plant material along bedding planes.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Composite from 0 to 17 feet (0 to 5 m) above Lower Kittanning coal

Chemical analysis: Mineralogy (X-ray): Raw properties:

	%		%	
SiO ₂	53.40	Quartz	25	Water of plasticity (%): 16.0
TiO ₂	0.98	Mica	64	Drying shrinkage (%): 0.0
Al ₂ O ₃	19.05	Kaolinite	5	Workability: Short
Fe ₂ O ₃	7.54	Chlorite-		Dry strength: Fair
MnO	0.125	vermiculite	5	Drying defects: None
MgO	1.76	Feldspar	1	pH: 5.2
CaO	0.50	Montmo-		
Na ₂ O	0.21	rillonite	0	
K ₂ O	3.35	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800 982	Beige	2	5.0	18.1	32.9	1.82
1900 1038	Red tan	3	5.0	11.9	24.1	1.99
2000 1093	Light red	3	5.0	11.3	22.4	2.01
2100 1149	Dark red	3	7.5	8.6	18.3	2.13
2200 1204	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND **Bloating test:** Positive

Remarks: Low plasticity. Abrupt vitrification (2100-2200°F). Good color at 2100°F.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lump

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800 982	--	--	--	--
1900 1038	1.58	98.6	14.2	No expansion.
2000 1093	1.25	78.0	19.9	Laminar expansion.
2100 1149	1.06	66.2	22.5	Fair pore structure.
2200 1204	0.64	39.9	20.6	Numerous large pores.
2300 1260	--	--	--	--

Remarks: Marginal raw material for lightweight aggregate; poor crushing characteristics.

Potential uses: Grade SW building brick; Type FBS facing brick; drain tile; marginal raw material for lightweight aggregate.

LAWRENCE COUNTY Taylor Twp. New Castle South quad.Sample number **5-B-31A**

Location: Roadcut exposure along the north side of the U.S. Route 422 bypass, about 2500 feet (760 m) east of its point of intersection with Pa. Route 168.

Latitude: 40°58'05"N

Longitude: 80°21'14"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Olive-gray to medium-gray, interbedded fissile shales and thin-bedded, slightly silty shales are exposed for an interval of 6 feet (1.8 m) above the Middle Kittanning(?) coal. The coal measures 17 inches (43 cm) in thickness. Iron staining is slight in the shales.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 6 stratigraphic feet (1.8 m) of shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	55.40	Quartz	18	Water of plasticity (%): 18.8
TiO ₂	0.98	Mica	56	Drying shrinkage (%): 5.0
Al ₂ O ₃	18.80	Kaolinite	21	Workability: Plastic
Fe ₂ O ₃	7.98	Chlorite-		Dry strength: Fair
MnO	0.118	vermiculite	4	Drying defects: None
MgO	1.63	Feldspar	1	pH: 8.2
CaO	0.47	Montmo-		
Na ₂ O	0.18	rillonite	0	
K ₂ O	3.44	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	18.0	32.3	1.80
982	(5YR6/6)					
1900	Brownish orange	3	7.5	14.2	27.2	1.91
1038	(5YR5/6)					
2000	Moderate reddish	4	7.5	9.8	20.4	2.05
1093	brown (2.5YR4/4)					
2100	Moderate reddish	5	10.0	9.7	19.9	2.08
1149	brown (2.5YR3/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Positive

*Munsell designation

Remarks: Abrupt vitrification (2100-2200°F). Scumming.

Bloating tests (quick-firing):

Crushing characteristics: Platy

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	2.19	136.7	7.7	No expansion.
982				
1900	2.13	132.9	7.2	No expansion.
1038				
2000	1.95	121.7	8.5	Slight expansion.
1093				
2100	1.40	87.4	11.6	Partial expansion.
1149				
2200	1.02	63.7	15.4	Overfired.
1204				
2300	--	--	--	--
1260				

Potential uses: Marginal raw material for lightweight aggregate. Short range.

LAWRENCE COUNTY Taylor Twp. New Castle South quad.

Sample number **5-B-31B**

Location: Roadcut exposure on the north side of the U.S. Route 422 bypass, about 2500 feet (760 m) east of its point of intersection with Pa. Route 168.

Latitude: 40°58'05"N

Longitude: 80°21'19"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Olive-gray underclay to the Middle Kittanning coal is exposed for an interval of 8 feet (2.4 m). Iron staining is present along fractures in the underclay. The underclay breaks down into hackly fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 8 stratigraphic feet (2.4 m) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	52.70	Quartz	12	Water of plasticity (%): 20.5
TiO ₂	1.85	Mica	38	Drying shrinkage (%): 5.0
Al ₂ O ₃	30.30	Kaolinite	44	Workability: Plastic
Fe ₂ O ₃	2.08	Chlorite-		Dry strength: Good
MnO	0.018	vermiculite	0	Drying defects: None
MgO	0.66	Feldspar	1	pH: 7.6
CaO	0.30	Montmo-		
Na ₂ O	0.15	rillonite	4	
K ₂ O	2.00	Calcite	1	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Yellowish white	3	7.5	15.5	28.7	1.85
982	(10YR9/1)					
1900	Yellowish white	5	10.0	13.1	25.6	1.95
1038	(10YR9/1)					
2000	Yellowish white	5	10.0	10.3	21.0	2.04
1093	(5Y9/1)					
2100	Yellowish white to	6	10.0	9.7	20.0	2.07
1149	gray (2.5Y8.5/2)					
2200	Yellowish gray	6	12.5	5.6	12.2	2.18
1204	(2.5Y8/2)					
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Abrupt vitrification (2200-2300°F). No effervescence when treated with HCl.

Potential uses: Type FBS facing brick. Structural tile (facing).

*Munsell designation

LAWRENCE COUNTY Taylor Twp. New Castle South quad.

Sample number **5-B-31C**

Location: Roadcut exposure on the north side of the U.S. Route 422 bypass, about 2500 feet (760 m) east of its point of intersection with Pa. Route 168.

Latitude: 40°58'05"N

Longitude: 80°21'24"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Light-gray, leached(?), silty underclay is exposed beneath 16 inches (41 cm) of coaly shale, the latter beneath 39 inches (99 cm) of bony coal. The bony coal is believed to represent the Lower Kittanning seam. The underclay contains some plant debris and is iron stained along some fractures. It breaks down into hackly fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Channel through 52 inches (132 cm) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	>72.00	Quartz	47	Water of plasticity (%):	20.0
TiO ₂	0.92	Mica	25	Drying shrinkage (%):	5.0
Al ₂ O ₃	14.05	Kaolinite	27	Workability:	Short
Fe ₂ O ₃	1.03	Chlorite-		Dry strength:	Good
MnO	0.010	vermiculite	0	Drying defects:	None
MgO	0.38	Feldspar	1	pH:	4.7
CaO	0.05	Montmo-			
Na ₂ O	0.11	rillonite	0		
K ₂ O	1.67	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Yellowish white	2	5.0	18.0	31.7	1.76
982	(10YR9/2)					
1900	Yellowish white	2	5.0	17.3	30.7	1.77
1038	(10YR9/2)					
2000	Yellowish white	3	5.0	16.1	29.2	1.81
1093	(2.5Y9/2)					
2100	Yellowish white	3	7.5	15.8	28.6	1.82
1149	(2.5Y8.5/2)					
2200	Yellowish gray	5	7.5	10.1	20.1	1.99
1204	(2.5Y8/2)					
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Abrupt vitrification (2200-2300°F). Too soft. No effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

LAWRENCE COUNTY Taylor Twp. New Castle South quad.Sample number **5-B-31D**

Location: Roadcut exposure on the north side of the U.S. Route 422 bypass, about 2500 feet (760 m) east of its point of intersection with Pa. Route 168.

Latitude: 40°58'04"N

Longitude: 80°21'29"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Medium- to medium-dark-gray, thin-bedded shales and silty shales occur for a stratigraphic thickness of about 20 feet (6 m) above the Vanport Limestone. Siderite nodules, commonly ranging from 1 to 5 inches (2.5 to 13 cm) in length, are present in the lower 6 feet (1.8 m) of the shale interval. Iron staining is slight to moderate in the shales. The shales break down into platy fragments having angular edges.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Composite of 20 stratigraphic feet (6 m) of shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	62.10	Quartz	26	Water of plasticity (%): 18.7	
TiO ₂	0.87	Mica	51	Drying shrinkage (%): 5.0	
Al ₂ O ₃	15.30	Kaolinite	21	Workability: Short	
Fe ₂ O ₃	7.21	Chlorite-		Dry strength: Fair	
MnO	0.075	vermiculite	0	Drying defects: None	
MgO	1.61	Feldspar	2	pH: 7.1	
CaO	0.90	Montmo-			
Na ₂ O	0.38	rillonite	0		
K ₂ O	2.81	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	17.8	32.1	1.81
982	(5YR6/6)					
1900	Grayish reddish	3	5.0	16.5	30.7	1.86
1038	orange (2.5YR5/6)					
2000	Moderate reddish	4	10.0	11.9	23.9	2.00
1093	brown (2.5YR4/4)					
2100	Moderate reddish	5	10.0	10.3	21.3	2.07
1149	brown (2.5YR4/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

*Munsell designation

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

LAWRENCE COUNTY Taylor Twp. New Castle South quad.

Sample number **5-B-31E**

Location: Roadcut exposure on the north side of the U.S. Route 422 bypass, about 2500 feet (760 m) east of its point of intersection with Pa. Route 168.

Latitude: 40°58'04"N

Longitude: 80°21'36"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Dark-gray to olive-gray underclay occurs beneath a 20-inch (51-cm) coal believed to represent the Scrubgrass coal. The underclay measures 31 inches (79 cm) in thickness. It breaks down into hackly fragments. It also effervesces when treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 31 inches (79 cm) of underclay

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	63.90	Quartz	38	Water of plasticity (%): 19.0
TiO ₂	1.18	Mica	33	Drying shrinkage (%): 5.0
Al ₂ O ₃	20.40	Kaolinite	23	Workability: Plastic
Fe ₂ O ₃	2.20	Chlorite-		Dry strength: Good
MnO	0.013	vermiculite	0	Drying defects: None
MgO	0.70	Feldspar	2	pH: 8.1
CaO	0.27	Montmo-		
Na ₂ O	0.17	rillonite	4	
K ₂ O	2.31	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Pinkish white	3	5.0	14.7	27.4	1.87
982	(5YR9/2)					
1900	Pinkish white	3	7.5	13.4	25.5	1.90
1038	(5YR9/2)					
2000	Yellowish white	4	7.5	10.7	21.3	2.00
1093	(10YR9/2)					

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2100 1149	Pale orange yellow (10YR8/4)	4	10.0	9.6	19.5	2.03
2200 1204	Yellowish gray (2.5Y7/2)	5	10.0	4.7	10.0	2.09
2300 1260	Grayish yellow (2.5Y7/4)	6	10.0	3.6	7.6	2.14

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Very good color range. Good firing range.

Potential uses: Type FBS facing brick. Structural tile (facing).

*Munsell designation

LAWRENCE COUNTY Shenango Twp. New Castle South quad.

Sample number 5-B-32A

Location: Roadcut exposure on the south side of the U.S. Route 422 bypass, about 6800 feet (2070 m) east of its point of intersection with Pa. Route 168.

Latitude: 40°58'08"N

Longitude: 80°20'27"W

Geologic unit: Pottsville Group

Description: Eleven inches (28 cm) of hard underclay occurs beneath a 40-inch (102-cm) sequence of coal, silty claystone, and bony coal. This hard clay, light brownish gray in color, is underlain by 32 inches (81 cm) of plastic underclay. The hard underclay breaks into relatively large, rubbly fragments that average about 3 inches (7.6 cm) in size.

Attitude of bedding: E-W; 2S

Weathering intensity: Slight

Sampled interval: Channel through 11 inches (28 cm) of hard underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	>75.00	Quartz	76	Water of plasticity (%): 18.7
TiO ₂	1.12	Mica	16	Drying shrinkage (%): 2.5
Al ₂ O ₃	8.70	Kaolinite	7	Workability: Short
Fe ₂ O ₃	0.70	Chlorite-		Dry strength: Good
MnO	0.003	vermiculite	0	Drying defects: None
MgO	0.25	Feldspar	1	pH: 3.8

Chemical analysis: Mineralogy (X-ray):

	%		%
CaO	0.01	Montmo-	
Na ₂ O	0.08	rillonite	0
K ₂ O	1.13	Calcite	0

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Yellowish white	2	2.5	21.9	35.5	1.62
982	(10YR9/2)					
1900	Yellowish white	2	2.5	21.6	35.4	1.64
1038	(10YR9/2)					
2000	Yellowish white	2	5.0	20.6	34.3	1.67
1093	(2.5Y9/2)					
2100	Yellowish white	2	5.0	20.1	33.9	1.68
1149	(2.5Y9/2)					
2200	Yellowish gray	5	5.0	14.9	26.8	1.79
1204	(2.5Y8.5/2)					
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2200-2300°). Too soft. Staining.

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

LAWRENCE COUNTY Shenango Twp. New Castle South quad.

Sample number **5-B-32B**

Location: Roadcut exposure on the south side of the U.S. Route 422 bypass, about 6800 feet (2070 m) east of its point of intersection with Pa. Route 168.

Latitude: 40°58'08"N

Longitude: 80°20'27"W

Geologic unit: Pottsville Group

Description: Light-brown-gray to olive-gray, plastic underclay occurs beneath the hard underclay collected as sample 5-B-32A. This plastic underclay is 32 inches (81 cm) thick. It breaks down into hackly fragments. Brown iron staining is present in moderate amounts along fractures.

Attitude of bedding: E-W, 2S

Weathering intensity: Slight to moderate.

Sampled interval: Channel through 32 inches (81 cm) of plastic underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	> 72.00	Quartz	43	Water of plasticity (%): 21.8
TiO ₂	1.02	Mica	36	Drying shrinkage (%): 5.0
Al ₂ O ₃	15.10	Kaolinite	20	Workability: Plastic
Fe ₂ O ₃	1.18	Chlorite-		Dry strength: Good
MnO	0.003	vermiculite	0	Drying defects: None
MgO	0.47	Feldspar	1	pH: 4.4
CaO	0.03	Montmo-		
Na ₂ O	0.11	rillonite	0	
K ₂ O	2.19	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Yellowish white	2	5.0	17.8	31.3	1.76
982	(5Y9/1)					
1900	Yellowish white	3	5.0	15.8	28.6	1.81
1038	(5Y9/1)					
2000	Yellowish white	4	7.5	12.9	24.6	1.91
1093	(2.5Y9/2)					
2100	Grayish yellow	4	7.5	12.3	23.7	1.92
1149	(2.5Y8/4)					
2200	Yellowish gray	7	10.0	3.9	8.6	2.18
1204	(2.5Y8/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Type FBS facing brick; structural tile (load-bearing).

*Munsell designation

LAWRENCE COUNTY Shenango Twp. New Castle South quad.

Sample number **5-B-32C**

Location: Roadcut exposure on the south side of the U.S. Route 422 bypass, about 6800 feet (2070 m) east of its point of intersection with Pa. Route 168.

Latitude: 40°58'08"N

Longitude: 80°20'27"W

Geologic unit: Pottsville Group

Description: Light-brownish-gray to olive-gray silty clay, 17 inches (43 cm) thick, underlies the plastic underclay collected as sample 5-B-32B. The silty clay has light-tan to brown iron stains along fractures and breaks down into hackly fragments.

Attitude of bedding: E-W, 2S

Weathering intensity: Slight

Sampled interval: Channel through 17 inches (43 cm) of clay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	≥ 72.00	Quartz	56	Water of plasticity (%): 18.6
TiO ₂	0.88	Mica	25	Drying shrinkage (%): 2.5
Al ₂ O ₃	12.70	Kaolinite	18	Workability: Short
Fe ₂ O ₃	1.00	Chlorite-		Dry strength: Fair
MnO	0.003	vermiculite	0	Drying defects: None
MgO	0.43	Feldspar	1	pH: 4.9
CaO	0.01	Montmo-		
Na ₂ O	0.10	rillonite	0	
K ₂ O	2.18	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Yellowish white	2	5.0	17.3	30.5	1.76
982	(5Y9/1)					
1900	Yellowish white	2	5.0	16.4	29.4	1.79
1038	(5Y9/1)					
2000	Yellowish white	3	5.0	15.8	28.8	1.83
1093	(2.5Y8.5/2)					
2100	Yellowish white	3	5.0	14.4	26.6	1.85
1149	(2.5Y8.5/2)					
2200	Grayish yellow	6	7.5	7.5	15.6	2.07
1204	(2.5Y8/2)					
2300	Grayish yellow	6	7.5	5.4	11.8	2.20
1260	(2.5Y8/2)					

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Type FBS facing brick; structural tile (facing).

*Munsell designation

LAWRENCE COUNTY Shenango Twp. New Castle South quad.Sample number **5-B-32D**

Location: Roadcut exposure on the south side of the U.S. Route 422 bypass, about 6800 feet (2070 m) east of its point of intersection with Pa. Route 168.

Latitude: 40°58'08"N

Longitude: 80°20'27"W

Geologic unit: Pottsville Group

Description: Grayish-black, soft, carbonaceous shale and silty shale occur stratigraphically beneath sample 5-B-32C. The shale lies above a limestone interval which measures about 24 inches (61 cm) in thickness. The shale breaks down into chippy to platy fragments having angular edges. Fractures in the shale are moderately stained from iron. Siderite nodules are present in the lower 2 feet (0.6 m) of the shale interval.

Attitude of bedding: E-W, 2S**Weathering intensity:** Slight to moderate**Sampled interval:** Channel sample through 10 stratigraphic feet (3 m) of shale**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	72.00	Quartz	43	Water of plasticity (%): 21.4
TiO ₂	0.88	Mica	40	Drying shrinkage (%): 2.5
Al ₂ O ₃	14.60	Kaolinite	11	Workability: Plastic
Fe ₂ O ₃	6.03	Chlorite-		Dry strength: Fair
MnO	0.034	vermiculite	2	Drying defects: None
MgO	1.21	Feldspar	4	pH: 3.4
CaO	0.24	Montmo-		
Na ₂ O	2.10	rillonite	0	
K ₂ O	2.91	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	18.1	31.9	1.76
982	(5YR6/6)					
1900	Grayish reddish	3	5.0	14.6	27.2	1.85
1038	orange (2.5YR5/6)					
2000	Strong brown	4	10.0	10.4	20.6	1.98
1093	(2.5YR4/6)					
2100	Moderate reddish	4	10.0	8.2	16.9	2.07
1149	brown (2.5YR4/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Munsell designation**

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Type FBS facing brick.

LAWRENCE COUNTY Shenango Twp. New Castle South quad.

Sample number 5-B-32E

Location: Roadcut exposure on the south side of the U.S. Route 422 bypass, about 6800 feet (2070 m) east of its point of intersection with Pa. Route 168.

Latitude: 40°58'08"N

Longitude: 80°20'27"W

Geologic unit: Pottsville Group

Description: Light- to medium-light-gray underclay, 36 inches (91 cm) thick, occurs below a coal interval which measures 25 inches (64 cm). The coal is believed to represent the Middle Mercer. The underclay breaks down into hackly fragments having angular edges; many fragments are of very small size, measuring 1/4 inch (0.6 cm) or less. Iron staining, reddish brown to brown in color, is common along fractures in the underclay.

Attitude of bedding: E-W, 2S

Weathering intensity: Slight to moderate

Sampled interval: Channel through 36 inches (91 cm) of underclay

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	66.00	Quartz	36	Water of plasticity (%): 19.5
TiO ₂	0.98	Mica	47	Drying shrinkage (%): 5.0
Al ₂ O ₃	16.05	Kaolinite	16	Workability: Plastic
Fe ₂ O ₃	4.40	Chlorite-		Dry strength: Good
MnO	0.018	vermiculite	0	Drying defects: None
MgO	0.65	Feldspar	1	pH: 4.4
CaO	0.17	Montmo-		
Na ₂ O	0.13	rillonite	0	
K ₂ O	2.73	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Pale orange yellow (7.5YR8/4)	2	5.0	15.5	28.7	1.85

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1900	Light yellowish	3	5.0	14.4	27.2	1.89
1038	brown (7.5YR7/4)					
2000	Light brown	4	7.5	11.8	20.6	2.00
1093	(7.5YR6/4)					
2100	Light brown	5	7.5	9.9	20.4	2.05
1149	(7.5YR6/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). Scumming. No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

LAWRENCE COUNTY Slippery Rock Twp. New Castle South quad.

Sample number **5-B-33**

Location: Exposure along the north side of U.S. Route 422, about 6300 feet (1920 m) east of the village of Altman.

Latitude: 40°58'24"N

Longitude: 80°15'22"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Dark-gray, light-olive-brown, and light-gray interbedded shales and silty shales are exposed for a stratigraphic interval of about 10 feet (3 m). A few thin beds of siltstone, measuring less than 2 inches (5.1 cm) in thickness, also occur in the sampled interval. Fragments of material are usually either platy or flaggy. Minor amounts of manganese and iron staining are present along fractures.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 10 stratigraphic feet (3 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	55.20	Quartz	21	Water of plasticity (%): 23.5	
TiO ₂	1.01	Mica	56	Drying shrinkage (%): 5.0	
Al ₂ O ₃	16.70	Kaolinite	11	Workability: Short	
Fe ₂ O ₃	8.50	Chlorite-		Dry strength: Fair	
MnO	0.117	vermiculite	6	Drying defects: None	
MgO	1.68	Feldspar	6	pH: 7.6	
CaO	0.25	Montmo-			
Na ₂ O	0.67	rillonite	0		
K ₂ O	2.82	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	23.9	38.5	1.61
982	(5YR6/6)					
1900	Grayish reddish	2	5.0	22.1	36.9	1.67
1038	orange (2.5YR5/6)					
2000	Moderate reddish	3	10.0	17.9	32.0	1.78
1093	brown (2.5YR4/4)					
2100	Moderate reddish	4	10.0	15.7	29.0	1.85
1149	brown (2.5YR4/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F). Too soft. No effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

LAWRENCE COUNTY Little Beaver Twp. New Galilee quad.

Sample number 5-C-25

Location: Strip pit operated by Ralph A. Veon, located about 8500 feet (2590 m) west of Enon Valley.

Latitude: 40°51'13"N

Longitude: 80°29'20"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Gray underclay to the Lower Kittanning coal occurs from 0 to 4 feet (0 to 1.2 m) below the coal in this pit. The lower foot (0.3 m) of the underclay is hard and may be flintlike. The upper 0.2 foot (0.06 m) of the underclay is medium dark gray in color due to the increase in organic material.

Attitude of bedding: Dips about 3 degrees to the east

Weathering intensity: Unweathered

Sampled interval: Channel through 4 feet (1.2 m) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	58.90	Quartz	20	Water of plasticity (%): 20.0
TiO ₂	1.28	Mica	33	Drying shrinkage (%): 5.0
Al ₂ O ₃	21.20	Kaolinite	12	Workability: Plastic
Fe ₂ O ₃	2.58	Chlorite-		Dry strength: Good
MnO	0.013	vermiculite	0	Drying defects: None
MgO	1.05	Feldspar	0	pH: 5.2
CaO	0.41	Montmo-		
Na ₂ O	0.18	rillonite	33	
K ₂ O	3.14	Calcite	0	
		Siderite	1	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	10.0	16.5	30.1	1.82
982						
1900	Cream	3	10.0	11.7	22.9	1.96
1038						
2000	Tan	3	10.0	9.0	18.8	2.09
1093						
2100	Tan	3	10.0	8.9	18.8	2.11
1149						
2200	Buff	4	10.0	5.8	12.7	2.21
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: A stoneware-type clay of fair quality. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile; Type H floor brick.

LAWRENCE COUNTY Scott Twp. Harlansburg quad.Sample number **14-C-1**

Location: Quarry pit along the east side of Pa. Route 108, about 1100 feet (340 m) east of the intersection of U.S. Route 19 and Pa. Route 108 in Harlansburg.

Latitude: **41°01'32"N**Longitude: **80°11'05"W**

Geologic unit: Lower part of the Allegheny Group

Description: Medium-gray shale underlies from 5 to 10 feet (1.5 to 3 m) of glacial material in the pit. When weathered, the shale is moderate to dark yellow brown. The stratigraphic interval of exposed shale measures 6 feet (1.8 m), but it is probably at least 15 feet (5 m) thick, the lower 9 feet (2.7 m) being covered by slump material in the pit. The shale breaks down to platy fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate to severe

Sampled interval: Channel through 6 stratigraphic feet (1.8 m) of shale

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	63.50	Quartz	28	Water of plasticity (%): 19.7
TiO ₂	1.03	Mica	57	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.60	Kaolinite	11	Workability: Short
Fe ₂ O ₃	7.14	Chlorite-		Dry strength: Fair
MnO	0.085	vermiculite	3	Drying defects: None
MgO	1.49	Feldspar	1	pH: 6.2
CaO	0.22	Montmo-		
Na ₂ O	0.18	rillonite	0	
K ₂ O	3.57	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	19.9	34.4	1.73
982	(5YR7/6)					
1900	Moderate orange	3	5.0	17.6	31.9	1.81
1038	(5YR6/6)					
2000	Brownish orange	3	7.5	15.7	29.5	1.88
1093	(5YR5/6)					
2100	Grayish reddish	4	7.5	12.7	25.3	1.99
1149	orange (2.5YR5/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

*Munsell designation

Remarks: No effervescence when treated with HCl. Abrupt vitrification (2100-2200°F). Too soft.

Potential uses: Not suitable for use in vitreous clay products.

LAWRENCE COUNTY Slippery Rock Twp. Portersville quad.

Sample number **15-A-11**

Location: Road exposure along the south side of U.S. Route 422, directly south of the village of Rose Point.

Latitude: 40°58'08"N

Longitude: 80°11'09"W

Geologic unit: Pottsville Group

Description: Olive-gray to gray-black shales occur stratigraphically below siltstones for a measured interval of 10 feet (3 m). Iron staining is intense on fragments of the shale. The fragments are platy and have angular edges.

Attitude of bedding: N45E, 4NW

Weathering intensity: Moderate

Sampled interval: Channel through 10 stratigraphic feet (3 m) of shale

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	55.60	Quartz	16	Water of plasticity (%): 23.5
TiO ₂	0.91	Mica	58	Drying shrinkage (%): 5.0
Al ₂ O ₃	21.15	Kaolinite	21	Workability: Plastic
Fe ₂ O ₃	6.48	Chlorite-		Dry strength: Good
MnO	0.073	vermiculite	2	Drying defects: None
MgO	1.40	Feldspar	3	pH: 5.4
CaO	0.36	Montmo-		
Na ₂ O	0.19	rillonite	0	
K ₂ O	4.18	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	3	5.0	16.7	30.4	1.82
982	(5YR7/6)					
1900	Moderate orange	4	10.0	11.0	22.0	2.00
1038	(2.5YR6/8)					
2000	Strong brown	6	12.5	4.8	10.7	2.23
1093	(2.5YR4/6)					

Slow-firing tests:

Temp. (°F) (°C)	Color*	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2100	Strong brown	6	12.5	3.9	8.8	2.25
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Positive

Remarks: Abrupt vitrification (1900-2000°F). Scumming. No effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

*Munsell designation

LAWRENCE COUNTY Perry Twp. Portersville quad.

Sample number 15-A-12

Location: Small excavation (pit) along the north side of Pa. Route 488, about 7000 feet (2130 m) by road south and west of the village of Pleasant Hill.

Latitude: 40°52'44"N

Longitude: 80°12'45"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Light-olive-gray to dark-gray, interbedded shales and silty shales are exposed in a pit that is about 20 feet (6 m) deep. Beds range in thickness from less than an inch (2.5 cm) up to about 2 inches (5 cm). Fragments of the material are platy to flaggy and have angular edges. The material does not effervesce when treated with dilute hydrochloric acid.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Composite through the lowest 10 stratigraphic feet (3 m) in the pit

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	58.90	Quartz	15	Water of plasticity (%): 22.7
TiO ₂	0.95	Mica	65	Drying shrinkage (%): 5.0
Al ₂ O ₃	18.50	Kaolinite	9	Workability: Short
Fe ₂ O ₃	8.46	Chlorite-		Dry strength: Good
MnO	0.114	vermiculite	5	Drying defects: None
MgO	1.90	Feldspar	6	pH: 6.2

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	0.21	Montmo-	
Na ₂ O	0.70	rillonite	0
K ₂ O	3.33	Calcite	0

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	19.6	33.9	1.73
982	(5YR7/6)					
1900	Brownish orange	3	7.5	14.9	27.8	1.87
1038	(2.5YR5/8)					
2000	Grayish reddish	5	12.5	8.3	17.4	2.10
1093	orange (2.5YR5/6)					
2100	Strong brown	5	12.5	5.8	12.6	2.18
1149	(2.5YR4/6)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Positive

Remarks: Abrupt vitrification (2100-2200°F). Scumming.

*Munsell designation

Bloating tests (quick-firing):

Crushing characteristics: Angular Particle size: -3/4" (1.9 cm) lumps
Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	2.21	137.9	8.1	No expansion.
982				
1900	2.15	134.2	8.2	No expansion.
1038				
2000	2.09	130.4	6.4	Slight expansion.
1093				
2100	1.80	112.3	7.9	Slight expansion.
1149				
2200	0.88	54.9	10.9	Good pore structure.
1204				
2300	--	--	--	--
1260				

Potential uses: Promising raw material for lightweight aggregate.

LAWRENCE COUNTY Perry Twp. Portersville quad.Sample number **15-A-13**

Location: Exposure along the east side of a medium-duty road which generally parallels Slippery Rock Creek, about 400 feet (120 m) south of Armstrong Bridge.

Latitude: 40°54'09"N

Longitude: 80°13'28"W

Geologic unit: Clarion Formation, Allegheny Group

Description: Light- to dark-gray, interbedded claystones and silty claystones are exposed for a measured stratigraphic interval of 9 feet (2.7 m). Cover masks the bottom contact of this interval, which may be up to 15 feet (5 m) thick. The material weathers to brown colors, and iron-stained zones rim gray claystone in some places. Partings occur at intervals of up to 2 inches (5.1 cm). The claystone is broken with relative ease into hackly to rubbly fragments.

Attitude of bedding: N35E, 7E**Weathering intensity:** Moderate**Sampled interval:** Composite sample representing 9 stratigraphic feet (2.7 m)**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	>72.00	Quartz	28	Water of plasticity (%): 19.1
TiO ₂	0.88	Mica	52	Drying shrinkage (%): 5.0
Al ₂ O ₃	14.00	Kaolinite	10	Workability: Short
Fe ₂ O ₃	5.80	Chlorite-		Dry strength: Fair
MnO	0.098	vermiculite	3	Drying defects: None
MgO	0.98	Feldspar	2	pH: 5.8
CaO	0.13	Montmo-		
Na ₂ O	0.12	rillonite	5	
K ₂ O	2.45	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	17.2	31.2	1.81
982	(5YR7/6)					
1900	Moderate orange	3	5.0	16.0	29.3	1.83
1038	(5YR6/6)					
2000	Grayish reddish	4	7.5	14.2	26.9	1.89
1093	orange (2.5YR5/6)					
2100	Strong brown	4	7.5	12.6	24.6	1.95
1149	(2.5YR4/6)					

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color *</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2200	Grayish reddish	7	10.0	3.9	8.3	2.14
1204	brown (2.5YR4/2)					
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

LAWRENCE COUNTY Perry Twp. Zelienople quad.

Sample number **15-C-14**

Location: Quarry located along the east side of Pa. Route 488, about 1 mile (1.6 km) northeast of the school in Wurtemberg.

Latitude: 40°52'00"N

Longitude: 80°13'58"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Medium- to medium-dark-gray claystones interbedded with a few siltstone beds are exposed in a quarry which is about 20 feet (6 m) deep. Partings suggestive of bedding indicate that the average thickness of claystone beds may be about 3 inches (7.6 cm). Siderite nodules up to 4-1/2 inches (11.4 cm) long occur occasionally in some portions of the exposure. Dark-yellow-orange and red-brown iron stains are present along fractures in moderate amounts. Fragments of the claystone are platy, hackly, and rubbly.

Attitude of bedding: N28E, 3E

Weathering intensity: Slight to moderate

Sampled interval: Composite through 15 stratigraphic feet (5 m) of claystones

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	56.30	Quartz	17	Water of plasticity (%):	20.5
TiO ₂	0.86	Mica	61	Drying shrinkage (%):	5.0
Al ₂ O ₃	21.35	Kaolinite	16	Workability:	Plastic
Fe ₂ O ₃	8.21	Chlorite-		Dry strength:	Good
MnO	0.086	vermiculite	4	Drying defects:	None
MgO	1.57	Feldspar	2	pH:	7.4
CaO	0.34	Montmo-			
Na ₂ O	0.21	rillonite	0		
K ₂ O	3.85	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color *	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Moderate orange	2	5.0	16.7	30.4	1.82
982	(5YR7/6)					
1900	Moderate orange	3	7.5	10.8	21.7	2.01
1038	(5YR6/6)					
2000	Strong brown	6	12.5	5.0	11.2	2.24
1093	(2.5YR4/6)					
2100	Moderate reddish	6	12.5	2.8	6.5	2.30
1149	brown (2.5YR4/4)					
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

*Munsell designation

SOMERSET COUNTY Jenner Twp. Somerset quad.

Sample number 58-D-1

Location: J.C.T. Construction Company coal stripping, located about 4500 feet (1370 m) along a bearing of N43E from the church nearest the B & O Railroad in Acosta.

Latitude: 40°07'12"N

Longitude: 79°03'32"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Base of sampled interval starts about 12 feet (4 m) above the Lower Kittanning coal. Sample consists of medium- to dark-gray, interbedded claystones and clayey siltstones in the lower 5 feet (1.5 m) and 6.5 feet (2.0 m) of very dark gray to dark-gray silty claystone above. Limestone nodules occur in the lower portion. Plant debris is common throughout. The claystones break down to form equant to blocky fragments.

Attitude of bedding: Dips about 2 degrees to the northwest

Weathering intensity: Negligible

Sampled interval: Composite representing 11.5 feet (3.5 m) of section

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	53.60	Quartz	23	Water of plasticity (%): 17.5
TiO ₂	1.09	Mica	47	Drying shrinkage (%): 2.5
Al ₂ O ₃	18.70	Kaolinite	23	Workability: Short
Fe ₂ O ₃	5.23	Chlorite-		Dry strength: Good
MnO	0.03	vermiculite	1	Drying defects: None
MgO	1.06	Feldspar	1	pH: 5.2
CaO	0.18	Montmo-		
Na ₂ O	0.14	rillonite	1	
K ₂ O	2.47	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Pink	2	2.5	22.1	37.2	1.69
1900 1038	Beige	4	5.0	19.4	34.1	1.76
2000 1093	Beige	5	7.5	17.2	31.6	1.84
2100 1149	Red brown	5	7.5	15.2	28.6	1.88
2200 1204	Yellow brown	6	7.5	10.9	21.9	2.00
2300 1260	Gray	6	10.0	9.2	18.3	2.00

Pyrometric cone equivalent: ND

Bloating test: Negative

Potential uses: Grade MW building brick; Type FBA facing brick; drain tile.

SOMERSET COUNTY Jenner Twp. Somerset quad.Sample number **58-D-2**

Location: J.C.T. Construction Company coal stripping, located about 4500 feet (1370 m) along a bearing of N43E from the church nearest the B & O Railroad in Acosta.

Latitude: 40°07'12"N**Longitude:** 79°03'32"W**Geologic unit:** Kittanning Formation, Allegheny Group

Description: Very dark gray, silty shales occur above the Middle Kittanning coal for a stratigraphic thickness of 13 feet (4 m). The shales are thickly laminated to very thin bedded and break into fissile or platy fragments. Iron staining is common along fractures. A bed of sandstone, 1.9 feet (0.6 m) thick, lies stratigraphically above the sampled interval.

Attitude of bedding: Dips about 2 degrees to the northwest**Weathering intensity:** Negligible**Sampled interval:** Composite representing 13 feet (4 m) of shale**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	56.70	Quartz	23	Water of plasticity (%): 18.4
TiO ₂	1.03	Mica	48	Drying shrinkage (%): 2.5
Al ₂ O ₃	17.00	Kaolinite	23	Workability: Plastic
Fe ₂ O ₃	8.55	Chlorite-		Dry strength: Good
MnO	0.13	vermiculite	3	Drying defects: None
MgO	1.52	Feldspar	3	pH: 7.7
CaO	0.32	Montmo-		
Na ₂ O	0.20	rillonite	0	
K ₂ O	2.91	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	18.0	33.0	1.84
982						
1900	Light brown	4	7.5	13.1	26.3	2.00
1038						
2000	Light brown	5	7.5	11.0	22.8	2.08
1093						
2100	Red brown	5	10.0	6.3	13.9	2.22
1149						
2200	Brown black	6.5	7.5	5.5	11.0	1.99
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Positive

Remarks: Slight effervescence when treated with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Laminar-angular Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.37	85.5	17.5	Slight expansion.
1093				
2100	0.73	45.6	25.5	Overfired.
1149				
2200	0.82	51.2	15.4	Overfired.
1204				
2300	--	--	--	--
1260				

Remarks: Mixture of bloating and nonbloating materials; marginal raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe; marginal raw material for lightweight aggregate.

SOMERSET COUNTY Jenner Twp. Somerset quad.

Sample number **58-D-3**

Location: J.C.T. Construction Company coal stripping, located about 4500 feet (1370 m) along a bearing of N43E from the church nearest the B & O Railroad in Acosta.

Latitude: 40°07'12"N

Longitude: 79°03'32"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Gray to yellowish-brown underclay to the Upper Kittanning coal extends for a distance of 5 feet (1.5 m) below the coal. Underneath the underclay is 1.5 feet (0.5 m) of black flinty clay which contains some limestone nodules.

Attitude of bedding: Dips about 2 degrees to the northwest

Weathering intensity: Slight

Sampled interval: Channel through 6.5 feet (2.0 m) of underclay and flint clay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	56.00	Quartz	13	Water of plasticity (%):	20.0
TiO ₂	1.04	Mica	42	Drying shrinkage (%):	5.0
Al ₂ O ₃	20.60	Kaolinite	44	Workability:	Plastic
Fe ₂ O ₃	8.29	Chlorite-		Dry strength:	Good
MnO	0.17	vermiculite	0	Drying defects:	None
MgO	0.66	Feldspar	1	pH:	5.2
CaO	0.41	Montmo-			
Na ₂ O	0.16	rillonite	0		
K ₂ O	2.70	Calcite	0		

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	5.0	19.9	35.0	1.76
982						
1900	Light brown	4	10.0	14.6	28.2	1.93
1038						
2000	Light brown	5	12.5	11.5	23.5	2.04
1093						
2100	Brown	5	15.0	6.4	14.3	2.24
1149						
2200	Dark gray	6.5	15.0	4.9	10.8	2.22
1204						
2300	Gray brown	7	15.0	2.8	6.3	2.22
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: High shrinkage. Good color at 2100°F. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe.

SOMERSET COUNTY Jenner Twp. Somerset quad.

Sample number 58-D-4

Location: J.C.T. Construction Company coal stripping, located about 4500 feet (1370 m) along a bearing of N43E from the church nearest the B & O Railroad in Acosta.

Latitude: 40°07'12"N

Longitude: 79°03'32"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Very light to very dark gray, silty, fissile to thin-bedded shales (roof shales) occur stratigraphically above the Upper Kittanning coal. Shales break to form platy to slabby fragments. Iron staining is present along fracture and bedding planes. A few siderite nodules are present also.

Attitude of bedding: Dips about 2 degrees to the northwest

Weathering intensity: Slight to moderate

Sampled interval: Composite representing 12 feet (4 m) of roof shale

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	53.90	Quartz	17	Water of plasticity (%): 24.5
TiO ₂	0.98	Mica	67	Drying shrinkage (%): 5.0
Al ₂ O ₃	20.70	Kaolinite	20	Workability: Plastic
Fe ₂ O ₃	7.28	Chlorite-		Dry strength: Good
MnO	0.06	vermiculite	3	Drying defects: None
MgO	0.90	Feldspar	2	pH: 5.0
CaO	0.12	Montmo-		
Na ₂ O	0.21	rillonite	1	
K ₂ O	3.20	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	4	7.5	21.5	36.3	1.69
982						
1900	Tan	5	10.0	13.7	26.4	1.93
1038						
2000	Light brown	5	10.0	9.9	20.6	2.09
1093						
2100	Brown	5	15.0	4.3	9.5	2.22
1149						
2200	Gray	6	15.0	3.6	8.2	2.26
1204						
2300	Light gray	6.5	12.5	2.2	4.8	2.21
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Good working and firing characteristics. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

SOMERSET COUNTY Jenner Twp. Somerset quad.

Sample number **58-D-5**

Location: J.C.T. Construction Company coal stripping, located about 4500 feet (1370 m) along a bearing of N43E from the church nearest the B & O Railroad in Acosta.

Latitude: 40°07'12"N

Longitude: 79°03'32"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Sampled interval occurs immediately below sample 58-D-3 and consists of 1 foot (0.3 m) of claystone, 5 feet (1.5 m) of silty claystones, and, in the basal portion, 2 feet (0.6 m) of gray underclay containing plant debris. Slickensides are present in the underclay.

Attitude of bedding: Dips about 2 degrees to the northwest

Weathering intensity: Slight

Sampled interval: Composite representing 8 feet (2.4 m) of section

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	56.20	Quartz	21	Water of plasticity (%): 20.0
TiO ₂	1.05	Mica	52	Drying shrinkage (%): 7.5
Al ₂ O ₃	20.85	Kaolinite	22	Workability: Plastic
Fe ₂ O ₃	6.27	Chlorite-		Dry strength: Good
MnO	0.06	vermiculite	4	Drying defects: None
MgO	1.45	Feldspar	2	pH: 6.5
CaO	0.28	Montmo-		
Na ₂ O	0.22	rillonite	0	
K ₂ O	3.57	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light tan	5	7.5	14.4	27.7	1.93
982						
1900	Tan	5	10.0	10.5	21.5	2.05
1038						
2000	Light brown	5	12.5	8.0	17.3	2.16
1093						
2100	Light brown	6	12.5	5.0	11.3	2.25
1149						
2200	Gray	6.5	12.5	4.4	9.6	2.16
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Fair working and firing characteristics. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

SOMERSET COUNTY Somerset Twp. Somerset quad.Sample number **58-D-6**

Location: Exposure in a drainage ditch along the east side of U.S. Route 219, located about 12,500 feet (3810 m) from the courthouse in Somerset along a bearing of N86-1/2E.

Latitude: 40°00'43"N

Longitude: 79°01'58"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Gray silty underclay to the Upper Kittanning(?) coal is exposed for a stratigraphic interval of 5.5 feet (1.7 m). Plant debris and slickensides are evident in the underclay.

Attitude of bedding: Dips about 2 degrees to the north

Weathering intensity: Slight to moderate

Sampled interval: Composite representing 5.5 stratigraphic feet (1.7 m) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	58.20	Quartz	22	Water of plasticity (%):	23.0
TiO ₂	1.22	Mica	40	Drying shrinkage (%):	7.5
Al ₂ O ₃	21.50	Kaolinite	30	Workability:	Plastic
Fe ₂ O ₃	4.24	Chlorite-		Dry strength:	Good
MnO	0.01	vermiculite	0	Drying defects:	None
MgO	0.69	Feldspar	1	pH:	5.4
CaO	0.23	Montmo-			
Na ₂ O	0.14	rillonite	5		
K ₂ O	2.52	Calcite	0		
		Goethite	3		
		Siderite	1		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light tan	5	7.5	17.6	31.6	1.80
982						
1900	Tan	6	12.5	10.8	21.7	2.01
1038						
2000	Tan	6	12.5	5.6	12.1	2.18
1093						
2100	Light brown	6.5	12.5	4.3	9.7	2.24
1149						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2200	Dark gray	7	12.5	2.9	6.5	2.26
1204						
2300	Gray	7	12.5	2.1	4.5	2.13
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Good working and firing characteristics. Might be glazed. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

SOMERSET COUNTY Somerset Twp. Somerset quad.

Sample number 58-D-7

Location: Exposure above a double entry to a mine located about 12,600 feet (3840 m) from the courthouse in Somerset along a bearing of N89E.

Latitude: 40°00'37"N

Longitude: 79°01'58"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Gray thin-bedded silty roof shale occurs for a stratigraphic interval of 11 feet (3 m) above the Upper Kittanning coal. A siltstone bed, 0.3 foot (0.1 m) thick, is present about 6 feet (2 m) above the coal. The roof shale breaks to form slabby fragments.

Attitude of bedding: Dips about 2 degrees to the north

Weathering intensity: Slight to moderate

Sampled interval: Composite representing 11 feet (3 m) of roof shale

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	64.50	Quartz	30	Water of plasticity (%): 23.7
TiO ₂	1.12	Mica	45	Drying shrinkage (%): 5.0
Al ₂ O ₃	17.90	Kaolinite	20	Workability: Plastic
Fe ₂ O ₃	5.21	Chlorite-		Dry strength: Good
MnO	0.08	vermiculite	3	Drying defects: None
MgO	0.92	Feldspar	1	pH: 5.7
CaO	0.14	Montmo-		
Na ₂ O	0.21	rillonite	2	
K ₂ O	2.87	Calcite	1	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	7.5	17.4	32.1	1.84
982						
1900	Light brown	4	7.5	12.5	24.7	1.97
1038						
2000	Light brown	5	10.0	10.6	21.6	2.04
1093						
2100	Brown	6	12.5	6.0	13.4	2.22
1149						
2200	Dark gray	6.5	12.5	3.4	7.7	2.26
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: No effervescence when treated with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Laminar-angular Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.72	107.3	7.8	No expansion.
1093				
2100	1.73	108.0	8.5	No expansion.
1149				
2200	1.15	71.8	6.1	Overfired.
1204				
2300	--	--	--	--
1260				

Remarks: Mixture of bloating and nonbloating materials; marginal raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBA facing brick; structural facing tile; marginal raw material for lightweight aggregate.

SOMERSET COUNTY Somerset Twp. Somerset quad.Sample number **58-D-8****Location:** Exposure located in a drainage ditch near a caved entry to a double-entry to a mine.**Latitude:** 40°00'37"N**Longitude:** 79°01'58"W**Geologic unit:** Freeport Formation, Allegheny Group**Description:** Gray underclay, 1.5 feet (0.5 m) thick, to an unidentified coal seam which occurs above the Upper Kittanning coal.**Attitude of bedding:** Dips about 2 degrees north**Weathering intensity:** Slight to moderate**Sampled interval:** Channel through 1.5 feet (0.5 m) of underclay**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	53.30	Quartz	18	Water of plasticity (%): 33.0
TiO ₂	1.20	Mica	53	Drying shrinkage (%): 7.5
Al ₂ O ₃	21.70	Kaolinite	45	Workability: Plastic
Fe ₂ O ₃	6.72	Chlorite-		Dry strength: Good
MnO	0.05	vermiculite	1	Drying defects: None
MgO	0.74	Feldspar	3	pH: 5.1
CaO	0.28	Montmo-		
Na ₂ O	0.16	rillonite	3	
K ₂ O	2.73	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light tan	3	10.0	21.9	35.2	1.62
982						
1900	Light tan	4	12.5	15.1	23.5	1.75
1038						
2000	Tan	6	15.0	7.5	14.8	1.97
1093						
2100	Light brown	6	15.0	2.5	5.2	2.10
1149						
2200	Dark gray	6.5	17.5	0.9	1.8	2.11
1204						
2300	--	--	Vitrified	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: Good working and firing characteristics. Might be glazed. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

SOMERSET COUNTY Somerset Twp. Somerset quad.

Sample number **58-D-9**

Location: Exposure above a double entry to a mine located about 12,600 feet (3840 m) from the courthouse in Somerset along a bearing of N89E.

Latitude: 40°00'37"N

Longitude: 79°01'58"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Thin-bedded silty shales occur below an unidentified coal seam which is the second coal above the Upper Kittanning coal. The shale breaks into platy or flaggy fragments. Iron staining is present along fractures and bedding planes in the shale. Shale interval is 20 feet (6 m) thick at the exposure.

Attitude of bedding: Dips about 2 degrees north

Weathering intensity: Moderate

Sampled interval: Composite representative of upper 10 feet (3 m) of shale interval

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	60.90	Quartz	20	Water of plasticity (%)	24.5
TiO ₂	1.20	Mica	66	Drying shrinkage (%)	5.0
Al ₂ O ₃	19.90	Kaolinite	6	Workability:	Plastic
Fe ₂ O ₃	7.95	Chlorite-		Dry strength:	Good
MnO	0.14	vermiculite	6	Drying defects:	None
MgO	1.02	Feldspar	1	pH:	5.7
CaO	0.17	Montmo-			
Na ₂ O	0.22	rillonite	0		
K ₂ O	3.17	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	7.5	16.1	29.6	1.84
982						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1900	Tan	3	7.5	14.0	26.9	1.92
1038						
2000	Light brown	5	10.0	8.8	18.3	2.08
1093						
2100	Brown	5	12.5	4.1	9.2	2.28
1149						
2200	Dark brown	6	12.5	0.7	1.6	2.37
1204						
2300	--	--	Vitrified	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Positive

Remarks: Good working and firing characteristics. No effervescence when treated with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Laminar-angular Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.52	94.8	7.6	Slight expansion.
1093				
2100	1.63	101.7	9.2	Slight expansion.
1149				
2200	1.22	76.1	12.7	Overfired.
1204				
2300	--	--	--	--
1260				

Remarks: Mixture of bloating and nonbloating materials; marginal raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile; marginal raw material for lightweight aggregate.

SOMERSET COUNTY Somerset Twp. Somerset quad.Sample number **58-D-10****Location:** Exposure above a double entry to a mine located about 12,600 feet (3840 m) from the courthouse in Somerset along a bearing of N89E.**Latitude:** 40°00'37"N**Longitude:** 79°01'58"W**Geologic unit:** Freeport Formation, Allegheny Group**Description:** Gray underclay to an unidentified coal which is stratigraphically the second coal above the Upper Kittanning coal. The underclay is 8 feet (2.4 m) thick, contains some plant debris, and has some iron staining along fractures and bedding planes. Slickensides are present also in the underclay.**Attitude of bedding:** Dips about 2 degrees north**Weathering intensity:** Moderately**Sampled interval:** Channel through 8 feet (2.4 m) of underclay**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	58.50	Quartz	24	Water of plasticity (%): 22.2
TiO ₂	1.08	Mica	53	Drying shrinkage (%): 2.5
Al ₂ O ₃	20.60	Kaolinite	12	Workability: Plastic
Fe ₂ O ₃	5.23	Chlorite-		Dry strength: Good
MnO	0.08	vermiculite	4	Drying defects: None
MgO	1.12	Feldspar	2	pH: 5.4
CaO	0.17	Montmo-		
Na ₂ O	0.24	rillonite	4	
K ₂ O	3.38	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light tan	4	5.0	16.5	30.6	1.86
982						
1900	Light tan	4	7.5	13.6	26.6	1.95
1038						
2000	Tan	6	7.5	10.2	21.3	2.09
1093						
2100	Brown	6	10.0	6.2	13.6	2.21
1149						
2200	Gray brown	6.5	12.5	3.4	7.7	2.26
1204						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2300 1260	Dark gray	7	12.5	3.3	6.9	2.11

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Good working and firing characteristics. Might be glazed. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

SOMERSET COUNTY Somerset Twp. Somerset quad.

Sample number **58-D-11**

Location: Exposure above a double entry to a mine located about 12,600 feet (3840 m) from the courthouse in Somerset along a bearing of N89E.

Latitude: 40°00'37"N

Longitude: 79°01'58"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Underclay which occurs as an interval splitting two 12-inch (30-cm) coal seams. The coal seams may represent the Lower Freeport coal. The underclay contains plant debris and has slickensides.

Attitude of bedding: Dips 2 degrees north

Weathering intensity: Slight

Sampled interval: Composite of underclay

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	41.90	Quartz	22	Water of plasticity (%): 26.2
TiO ₂	0.85	Mica	50	Drying shrinkage (%): 7.5
Al ₂ O ₃	16.45	Kaolinite	24	Workability: Plastic
Fe ₂ O ₃	5.00	Chlorite-		Dry strength: Good
MnO	0.04	vermiculite	1	Drying defects: None
MgO	0.76	Feldspar	2	pH: 5.3
CaO	0.51	Montmo-		
Na ₂ O	0.13	rillonite	2	
K ₂ O	2.06	Calcite	1	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Cream	5	7.5	25.2	40.3	1.60
982						
1900	Cream	5	7.5	22.3	37.0	1.66
1038						
2000	Light tan	5	10.0	18.2	31.9	1.75
1093						
2100	Gray tan	5	12.5	14.8	27.3	1.85
1149						
2200	Light gray	6.5	12.5	9.7	19.0	1.97
1204						
2300	Gray	7	15.0	8.8	17.2	1.95
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Good working and firing characteristics. Might be glazed. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

SOMERSET COUNTY Somerset Twp. Somerset quad.

Sample number 58-D-12

Location: Exposure above a double entry to a mine located about 12,600 feet (3840 m) from the courthouse in Somerset along a bearing of N89E.

Latitude: 40°00'37"N

Longitude: 79°01'58"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Interbedded shales and siltstone occur for a stratigraphic distance of 13.7 feet (4.2 m) above the Lower Freeport(?) coal. Beds generally are very thin to thin; a few siltstone beds measure up to 2 inches (5 cm) in thickness. Iron staining is present along fractures and bedding planes.

Attitude of bedding: Dips about 2 degrees north

Veathering intensity: Slight

Sampled interval: Composite representing 13.7 feet (4.2 m) of shale and siltstone

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	54.20	Quartz	19	Water of plasticity (%): 18.1
TiO ₂	1.15	Mica	56	Drying shrinkage (%): 2.5
Al ₂ O ₃	20.30	Kaolinite	21	Workability: Short
Fe ₂ O ₃	6.68	Chlorite-		Dry strength: Fair
MnO	0.08	vermiculite	4	Drying defects: None
MgO	0.91	Feldspar	1	pH: 5.7
CaO	0.28	Montmo-		
Na ₂ O	0.17	rillonite	1	
K ₂ O	2.87	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	22.7	37.7	1.65
982						
1900	Tan	3	5.0	19.9	34.2	1.71
1038						
2000	Light brown	4	10.0	12.9	24.3	1.89
1093						
2100	Brown	5	15.0	8.3	16.4	1.98
1149						
2200	Dark gray	6	15.0	5.3	10.0	1.90
1204						
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Low plasticity. Poor color. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; drain tile.

SOMERSET COUNTY Somerset Twp. Somerset quad.

Sample number 58-D-13

Location: Exposure above a double entry to a mine located about 12,600 feet (3840 m) from the courthouse in Somerset along a bearing of N89E.

Latitude: 40°00'37"N

Longitude: 79°01'58"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Sample consists of roof shales, siltstones, and underclay which are stratigraphically between two coals, probably within the upper part of the Freeport Formation. The sampled interval measures 8.9 feet (2.7 m).

Attitude of bedding: Dips 2 degrees north

Weathering intensity: Slight

Sampled interval: Channel through 8.9 feet (2.7 m) of section

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	60.10	Quartz	22	Water of plasticity (%): 14.1
TiO ₂	1.23	Mica	54	Drying shrinkage (%): 2.5
Al ₂ O ₃	21.00	Kaolinite	19	Workability: Short
Fe ₂ O ₃	4.28	Chlorite-		Dry strength: Poor
MnO	0.02	vermiculite	4	Drying defects: None
MgO	1.05	Feldspar	2	pH: 5.1
CaO	0.11	Montmo-		
Na ₂ O	0.15	rillonite	0	
K ₂ O	3.37	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	19.9	34.4	1.73
982						
1900	Tan	3	2.5	16.8	30.4	1.81
1038						
2000	Light brown	4	5.0	11.9	23.4	1.96
1093						
2100	Brown	5	5.0	9.2	18.7	2.04
1149						
2200	Gray	6	7.5	8.0	14.9	2.03
1204						
2300	Gray	6	7.5	8.1	12.9	2.00
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Potential uses: Grade SW building brick; drain tile.

SOMERSET COUNTY Milford Twp. Rockwood quad.

Sample number 59-A-5

Location: Coal stripping operated by Wm. E. Scurfield, located about 20,700 feet (6310 m) from the village of New Centerville along a bearing of N62E.

Latitude: 39°58'11"N

Longitude: 79°07'38"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium- to very dark gray shales grading stratigraphically upward into shaly siltstones and siltstones occur above the Upper Freeport coal. Several intervals of sandstone occur from 3 to 4 feet (0.9 to 1.2 m) and 7 to 9 feet (2.1 to 2.7 m) above the coal. Iron staining is present along bedding and fracture planes throughout most of the sampled interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Composite from 0 to 11 feet (0 to 3 m) above the Upper Freeport coal

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	57.60	Quartz	25	Water of plasticity (%)	15.7
TiO ₂	1.02	Mica	56	Drying shrinkage (%)	0.0
Al ₂ O ₃	18.65	Kaolinite	13	Workability	Short
Fe ₂ O ₃	8.42	Chlorite-		Dry strength	Poor
MnO	0.14	vermiculite	4	Drying defects	None
MgO	1.29	Feldspar	1	pH	5.9
CaO	0.42	Montmo-			
Na ₂ O	0.18	rillonite	2		
K ₂ O	2.88	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	0.0	21.9	38.5	1.76
982						
1900	Tan	3	2.5	15.5	29.2	1.89
1038						
2000	Brown	4	5.0	11.5	23.2	2.03
1093						
2100	Brown	5	5.0	9.7	20.2	2.08
1149						
2200	Dark gray	6	7.5	5.4	11.6	2.14
1204						
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Low plasticity. Poor color.

Potential uses: Grade SW building brick; drain tile.

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800 982	Light tan	3	5.0	15.3	28.8	1.87
1900 1038	Light tan	3	7.5	14.4	27.3	1.90
2000 1093	Tan	4	7.5	12.7	24.4	1.91
2100 1149	Gray tan	6	10.0	6.6	13.9	2.11

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2200	Gray	6	10.0	3.0	6.3	2.05
1204						
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Low plasticity. Good firing characteristics.

Potential uses: Grade SW building brick; Type FBS facing brick.

SOMERSET COUNTY Upper Turkeyfoot Twp. Rockwood quad.

Sample number 59-A-12

Location: Roadside exposure on the east side of light-duty road, located about 1600 feet (490 m) from the church in Casselman along a bearing of N56-1/2W.

Latitude: 39°53'18"N

Longitude: 79°12'57"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Dark-gray, semifissile to thin-bedded shales are exposed for a stratigraphic interval of 9 feet (2.7 m) above road level. The shale breaks to form papery, platy, or flaggy fragments. Some beds contain siderite nodules ranging from about 2 to 4 inches (5 to 10 cm) in long dimension.

Attitude of bedding: Dips 2 degrees northwest

Weathering intensity: Slight

Sampled interval: Composite from 9 stratigraphic feet (2.7 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	51.40	Quartz	15	Water of plasticity (%): 16.7
TiO ₂	0.86	Mica	66	Drying shrinkage (%): 5.0
Al ₂ O ₃	20.75	Kaolinite	8	Workability: Plastic
Fe ₂ O ₃	8.98	Chlorite-		Dry strength: Good
MnO	0.55	vermiculite	6	Drying defects: None
MgO	2.07	Feldspar	2	pH: 6.3

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	1.77	Montmo-	
Na ₂ O	0.21	rillonite	0
K ₂ O	3.18	Calcite	0
		Gypsum	1
		Pyrite	2

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Brown	3	7.5	18.3	34.0	1.84
982						
1900	Brown	4	12.5	9.0	19.5	2.18
1038						
2000	Brown	5	12.5	7.1	16.0	2.24
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND Bloating test: Positive

Remarks: Poor color. Abrupt vitrification. Slight effervescence when treated with HCl.

Bloating tests (quick-firing):
Crushing characteristics: Angular Particle size: -3/4" (1.9 cm) lumps
Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	0.99	61.8	23.7	Poor pore structure.
1093				
2100	0.78	48.7	23.3	Poor pore structure.
1149				
2200	0.63	39.3	78.5	Overbloomed; melting.
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate (poor pore structure, mixture).

Potential uses: Grade MW building brick; marginal raw material for lightweight aggregate.

SOMERSET COUNTY Upper Turkeyfoot Twp. Rockwood quad.

Sample number **59-A-13**

Location: Roadside exposure on the east side of a light-duty road, located about 1600 feet (490 m) from the church in Casselman along a bearing of N56-1/2W.

Latitude: 39°53'18"N

Longitude: 79°12'57"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-gray silty shales occur stratigraphically above the sample collected as 59-A-12. They appear to be massive but, when weathered, become fissile to thin bedded. Separating this sample from sample 59-A-12 is a gray limestone bed about one foot (0.3 m) thick.

Attitude of bedding: Dips 2 degrees northwest

Weathering intensity: Slight

Sampled interval: Channel through lower 8 feet (2.4 m) of a 15-foot (4.6-m) interval of shale

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	56.00	Quartz	24	Water of plasticity (%): 19.6
TiO ₂	0.97	Mica	57	Drying shrinkage (%): 0.0
Al ₂ O ₃	21.25	Kaolinite	14	Workability: Plastic
Fe ₂ O ₃	7.80	Chlorite-		Dry strength: Good
MnO	0.14	vermiculite	2	Drying defects: None
MgO	1.85	Feldspar	2	pH: 6.7
CaO	0.55	Montmo-		
Na ₂ O	0.24	rillonite	3	
K ₂ O	3.48	Calcite	0	
		Pyrophyllite	2	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Tan	3	2.5	13.3	25.3	1.91

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1900	Light brown	4	7.5	4.7	10.6	2.26
1038						
2000	Brown	7	10.0	0.7	1.6	2.43
1093						
2100	Dark brown	7	12.5	0.7	1.6	2.44
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Bloating tests (quick-firing):

Crushing characteristics: Platy

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.31	81.7	9.8	Slight expansion.
1093				
2100	0.98	61.2	11.6	Platy but good pore struc-
1149				ture.
2200	0.87	54.3	17.2	Platy but good pore struc-
1204				ture.
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate (poor crushing characteristics).**Potential uses:** Grade SW building brick; Type FBS facing brick; drain tile; marginal raw material for lightweight aggregate.**SOMERSET COUNTY Milford Twp. Rockwood quad.**

Sample number 59-A-14

Location: Strip mine operated by the Svonavic Coal Company, located about 7400 feet (2260 m) from New Centerville along a bearing of S31E.

Latitude: 39°55'30"N

Longitude: 79°10'42"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Gray underclay to the Upper Freeport coal occurs for a stratigraphic interval of 9.7 feet (3.0 m). A dark-gray to black band of carbonaceous clay, about 10 inches (25 cm) thick, is present between 6 and 7 feet (1.8 and 2.1 m) from the base. The lower 6 feet (1.8 m) of the sampled interval is silty. Minor amounts of plant debris, slickensides, and iron staining are present in the interval.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Unweathered**Sampled interval:** Channel through 9.7 feet (3.0 m) of underclay**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	45.00	Quartz	16	Water of plasticity (%): 20.6
TiO ₂	0.81	Mica	60	Drying shrinkage (%): 0.0
Al ₂ O ₃	14.30	Kaolinite	14	Workability: Short
Fe ₂ O ₃	19.30	Chlorite-		Dry strength: Fair
MnO	0.48	vermiculite	4	Drying defects: None
MgO	1.77	Feldspar	1	pH: 7.3
CaO	1.45	Montmo-		
Na ₂ O	0.10	rillonite	0	
K ₂ O	2.08	Calcite	1	
		Siderite	10	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Gray tan	3	2.5	18.4	32.6	1.77
982						
1900	Gray brown	4	5.9	12.1	24.3	2.01
1038						
2000	Gray brown	6	7.5	8.0	17.4	2.17
1093						
2100	Brown	6.5	10.0	3.4	7.8	2.33
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Poor color. Slight effervescence when treated with HCl.**Potential uses:** Grade SW building brick.

SOMERSET COUNTY Milford Twp. Rockwood quad.Sample number **59-A-15****Location:** Strip mine operated by the Svonavic Coal Company, located about 7400 feet (2260 m) from New Centerville along a bearing of S31E.**Latitude:** 39°55'30"N**Longitude:** 79°10'42"W**Geologic unit:** Freeport Formation, Allegheny Group**Description:** Gray silty underclay or clay parting in the Upper Freeport coal horizon occurs for a stratigraphic distance of 2.1 feet (0.6 m). Minor amounts of iron staining are present locally along fractures.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Unweathered**Sampled interval:** Channel through 2.1 feet (0.6 m) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	66.60	Quartz	31	Water of plasticity (%):	12.1
TiO ₂	1.20	Mica	49	Drying shrinkage (%):	0.0
Al ₂ O ₃	19.25	Kaolinite	18	Workability:	Short
Fe ₂ O ₃	3.17	Chlorite-		Dry strength:	Poor
MnO	0.01	vermiculite	1	Drying defects:	None
MgO	0.61	Feldspar	1	pH:	3.7
CaO	0.13	Montmo-			
Na ₂ O	0.18	rillonite	0		
K ₂ O	2.58	Calcite	0		

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Light tan	3	0.0	24.7	42.4	1.72
982						
1900	Tan	3	0.0	13.7	26.4	1.93
1038						
2000	Tan	3	0.0	12.2	24.1	1.97
1093						
2100	Gray tan	5	2.5	9.9	20.3	2.04
1149						
2200	Gray	5	2.5	7.7	15.8	2.05
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: Low plasticity. Prominent iron staining. No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

SOMERSET COUNTY Milford Twp. Rockwood quad.

Sample number **59-A-16**

Location: Strip mine operated by the Svonavic Coal Company, located about 7400 feet (2260 m) from New Centerville along a bearing of S31E.

Latitude: 39°55'30"N

Longitude: 79°10'42"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Gray to dark-gray, thin-bedded silty shales, interbedded with a few 0.2-foot- (0.1-m-) thick shaly sandstones, occur above the Upper Freeport coal. The lower 3 feet (0.9 m) of the sampled interval contains less silt than the upper 4.5 feet (1.4 m). Locally, a channel sandstone cuts through this interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel through 7.5 feet (2.3 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	60.90	Quartz	22	Water of plasticity (%): 19.7
TiO ₂	1.21	Mica	59	Drying shrinkage (%): 0.0
Al ₂ O ₃	20.35	Kaolinite	17	Workability: Short
Fe ₂ O ₃	4.80	Chlorite-		Dry strength: Fair
MnO	0.07	vermiculite	1	Drying defects: None
MgO	0.80	Feldspar	1	pH: 4.8
CaO	0.06	Montmo-		
Na ₂ O	0.19	rillonite	0	
K ₂ O	3.28	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	0.0	21.8	36.8	1.69
982						
1900	Tan	3	2.5	13.5	26.7	1.97
1038						
2000	Light brown	4	7.5	12.7	25.0	1.97
1093						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2100 1149	Brown	5	7.5	9.9	20.0	2.01
2200 1204	Red brown	5	7.5	9.4	19.7	2.10
2300 1260	Gray	6	10.0	3.3	7.1	2.14

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Low plasticity. Good color. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBA facing brick; drain tile.

SOMERSET COUNTY Brothersvalley Twp. Murdock quad.

Sample number **59-B-7**

Location: Coal stripping operated by the Ponfeigh Coal Company, located about 6900 feet (2100 m) from the village of Shober along a bearing of N15-1/2W.

Latitude: 39°54'35"N

Longitude: 79°01'47"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Very dark gray, fissile, roof slates, 1 foot (0.3 m) thick, change to medium- to dark-gray, thin-bedded silty shales stratigraphically upward over the next 6.5 feet (2.0 m) The silty shale interval contains disseminated pyrite throughout. The entire interval occurs above the Upper Freeport coal.

Attitude of bedding: Dips about 5 degrees southeast

Weathering intensity: Negligible

Sampled interval: Channel through 7.5 feet (2.3 m)

Chemical analysis: **Mineralogy (X-ray):** **Raw properties:**

	%		%	
SiO ₂	65.50	Quartz	37	Water of plasticity (%): 11.3
TiO ₂	1.23	Mica	42	Drying shrinkage (%): 5.0
Al ₂ O ₃	16.80	Kaolinite	18	Workability: Short
Fe ₂ O ₃	4.20	Chlorite-		Dry strength: Fair
MnO	0.04	vermiculite	3	Drying defects: None
MgO	1.13	Feldspar	1	pH: 6.7

Chemical analysis: Mineralogy (X-ray):

	%		%
CaO	0.15	Montmo-	
Na ₂ O	0.15	rillonite	0
K ₂ O	2.70	Calcite	0

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	5.0	16.7	29.5	1.77
982						
1900	Tan	3	5.0	15.2	27.9	1.84
1038						
2000	Light brown	4	7.5	13.9	25.9	1.86
1093						
2100	Brown	5	7.5	11.0	20.7	1.89
1149						
2200	Dark gray	6	7.5	8.4	15.9	1.88
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Low plasticity. Fair color at 1900°F. No effervescence when treated with HCl.**Potential uses:** Grade SW building brick; Type FBA facing brick.**SOMERSET COUNTY Brothersvalley Twp. Murdock quad.**Sample number **59-B-8****Location:** Coal stripping operated by the Ponfeigh Coal Company, located about 6900 feet (2100 m) from the village of Shoher along a bearing of N15-1/2W.**Latitude:** 39°54'35"N**Longitude:** 79°01'47"W**Geologic unit:** Allegheny Group, Freeport Formation**Description:** Gray, very silty underclay to the Upper Freeport rider coal occurs for a stratigraphic interval of 4.1 feet (1.2 m). The underclay contains plant debris, is slickensided in places, and shows iron staining on some fracture surfaces.**Attitude of bedding:** Dips 5 degrees southeast**Weathering intensity:** Negligible

Sampled interval: Channel through underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	69.90	Quartz	44	Water of plasticity (%):	19.6
TiO ₂	1.18	Mica	35	Drying shrinkage (%):	5.0
Al ₂ O ₃	18.35	Kaolinite	17	Workability:	Plastic
Fe ₂ O ₃	1.90	Chlorite-		Dry strength:	Good
MnO	0.02	vermiculite	2	Drying defects:	None
MgO	0.80	Feldspar	1	pH:	4.8
CaO	0.10	Montmo-			
Na ₂ O	0.16	rillonite	0		
K ₂ O	2.58	Calcite	1		

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Light tan	3	5.0	16.0	29.6	1.85
982						
1900	Light tan	5	10.0	11.2	22.1	1.97
1038						
2000	Tan	5	10.0	8.0	16.7	2.08
1093						
2100	Gray tan	6.5	12.5	2.8	6.3	2.27
1149						
2200	Gray	7	15.0	1.4	3.1	2.30
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Good color, might be glazed. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; stoneware.

SOMERSET COUNTY Brothersvalley Twp. Murdock quad.

Sample number **59-B-9**

Location: Coal stripping operated by the Ponfeigh Coal Company, located about 6900 feet (2100 m) from the village of Shoher along a bearing of N15-1/2W.

Latitude: 39°54'35"N

Longitude: 79°01'47"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-gray, slightly silty, fissile shale is exposed for a stratigraphic interval of 5.5 feet (1.7 m) above the rider to the Upper Freeport coal. Immediately above the shale is a 1-foot (0.3-m), fine-grained sandstone unit which is overlain by 6.5 feet (2.0 m) of dark-gray silty shale containing some pyrite. Iron staining is present along bedding and fracture planes in the lower 5.5 feet (1.7 m) of the sampled interval.

Attitude of bedding: Dips 5 degrees southeast

Weathering intensity: Negligible

Sampled interval: Composite through 13 feet (4 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	63.80	Quartz	28	Water of plasticity (%): 20.7
TiO ₂	1.05	Mica	50	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.05	Kaolinite	16	Workability: Plastic
Fe ₂ O ₃	4.87	Chlorite-		Dry strength: Good
MnO	0.04	vermiculite	5	Drying defects: None
MgO	1.19	Feldspar	3	pH: 4.9
CaO	0.11	Montmo-		
Na ₂ O	0.18	rillonite	0	
K ₂ O	3.14	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	18.9	32.9	1.74
982						
1900	Tan	4	7.5	14.9	27.8	1.87
1038						
2000	Light brown	5	10.0	10.7	21.3	2.00
1093						
2100	Brown	6	12.5	4.7	10.3	2.21
1149						
2200	Gray brown	6.5	12.5	3.4	7.4	2.18
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Positive

Remarks: Fair color at 1900°F. No effervescence when treated with HCl.

Bloating tests (quick-firing):Crushing characteristics: **Angular**Particle size: **-3/4" (1.9 cm) lumps**Retention time: **15 min.**

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.80	112.3	9.7	No expansion.
1093				
2100	1.05	65.5	19.4	Laminar expansion.
1149				
2200	0.79	49.3	13.2	Fair pore structure.
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate (mixture of bloating and nonbloating materials).

Potential uses: Grade SW building brick; Type FBS facing brick; marginal raw material for lightweight aggregate.

SOMERSET COUNTY Brothersvalley Twp. Murdock quad.Sample number **59-B-10**

Location: Coal stripping operated by the Ponfeigh Coal Company, located about 1800 feet (550 m) from the village of Burkholder along a bearing of N20W.

Latitude: 39°53'08"N**Longitude:** 79°02'08"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Sampled interval occurs above the Upper Freeport coal and consists of the following: 3.5 feet (1.1 m) of very dark gray, fissile shale; 2 feet (0.6 m) of gray, sandy shale which tends to be fissile; and 4 feet (1.2 m) of interbedded gray massive shaly sandstones and sandy shales, both types pinching and swelling laterally.

Attitude of bedding: Dips 5 degrees southeast

Weathering intensity: Negligible

Sampled interval: Composite of 9.5 feet (2.9 m) of section

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	65.70	Quartz	36	Water of plasticity (%):	18.5
TiO ₂	1.07	Mica	45	Drying shrinkage (%):	0.0
Al ₂ O ₃	17.45	Kaolinite	18	Workability:	Short
Fe ₂ O ₃	3.90	Chlorite-		Dry strength:	Fair
MnO	0.04	vermiculite	1	Drying defects:	None
MgO	1.25	Feldspar	1	pH:	7.5
CaO	0.12	Montmo-			
Na ₂ O	0.17	rillonite	0		
K ₂ O	2.93	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	15.3	27.9	1.83
982						
1900	Dark tan	3	5.0	13.0	24.7	1.89
1038						
2000	Light brown	5	7.5	7.1	14.9	2.09
1093						
2100	Brown	6	12.5	1.9	4.2	2.15
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Low plasticity. Fair color at 1900°F. Slight effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBA facing brick.

SOMERSET COUNTY Brothersvalley Twp. Murdock quad.

Sample number 59-B-11

Location: Coal stripping operated by the Ponfeigh Coal Company, located about 1800 feet (550 m) from the village of Burkholder along a bearing of N20W.

Latitude: 39°53'08"N

Longitude: 79°02'08"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Gray silty underclay to the Upper Freeport rider coal is exposed for a thickness of 3 feet (0.9 m). The upper 2 feet (0.6 m) of the underclay is massive, whereas the lower foot (0.3 m) is medium bedded. Plant debris is present in the underclay.

Attitude of bedding: Dips 5 degrees southeast

Weathering intensity: Negligible

Sampled interval: Channel through underclay

Chemical analysis:

%

SiO ₂	70.10
TiO ₂	1.17
Al ₂ O ₃	17.10
Fe ₂ O ₃	2.40
MnO	0.02
MgO	0.80
CaO	0.11
Na ₂ O	0.15
K ₂ O	2.28

Mineralogy (X-ray):

%

Quartz	36
Mica	40
Kaolinite	18
Chlorite-	
vermiculite	2
Feldspar	2
Montmo-	
rillonite	2
Calcite	0
Pyrophyllite	2

Raw properties:

Water of plasticity (%)	18.3
Drying shrinkage (%)	0.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	4.7

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	2.5	15.3	29.0	1.89
982						
1900	Tan	4	5.0	13.6	25.8	1.90
1038						
2000	Tan	5	7.5	12.5	24.3	1.94
1093						
2100	Gray tan	7	7.5	4.9	10.9	2.20
1149						
2200	Gray	7	12.5	1.3	3.0	2.27
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent:

ND

Bloating test:

Negative

Remarks: Low plasticity. Fair color at 2000°F; might be glazed. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile; stoneware.

SOMERSET COUNTY Summit Twp. Meyersdale quad.

Sample number **59-D-17**

Location: Stripping operated by the Sanner Bros. Coal Company, located about 5000 feet (1520 m) from the post office in Meyersdale along a bearing of N86W.

Latitude: 39°49'00"N

Longitude: 79°02'40"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Very dark gray shale occurs below a 10-inch (25-cm) coal which is believed to represent the rider #1 to the Sewickley coal. Silty stringers are common throughout the sampled interval. Concretions and nodules of siderite are present throughout the sequence. The shale breaks to form platy and splintery fragments. Iron stains are present along joint and bedding planes.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Composite representing 14.5 feet (4.4 m) of shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	50.70	Quartz	15	Water of plasticity (%): 15.1	
TiO ₂	0.97	Mica	54	Drying shrinkage (%): 2.5	
Al ₂ O ₃	17.95	Kaolinite	13	Workability: Short	
Fe ₂ O ₃	11.80	Chlorite-		Dry strength: Fair	
MnO	0.25	vermiculite	1	Drying defects: None	
MgO	0.81	Feldspar	1	pH: 6.5	
CaO	0.56	Montmo-			
Na ₂ O	0.17	rillonite	2		
K ₂ O	2.62	Calcite	1		
		Goethite	5		
		Pyrite present			
		Lepidocrocite present			

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light brown	3	2.5	27.9	43.4	1.55
982						
1900	Light brown	3	7.5	22.7	38.5	1.69
1038						
2000	Brown	3	10.0	19.5	34.7	1.77
1093						
2100	Brown	4	10.0	17.9	32.0	1.79
1149						
2200	Dark brown	5	12.5	17.2	28.9	1.74
1204						
2300	Dark gray	6	12.5	10.7	20.3	1.90
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Low plasticity. High maturing temperature. Slight effervescence when treated with HCl.

Potential uses: Grade MW building brick.

SOMERSET COUNTY Summit Twp. Meyersdale quad.Sample number **59-D-18**

Location: Stripping operated by the Sanner Bros. Coal Company, located about 5000 feet (1520 m) from the post office in Meyersdale along a bearing of N86W.

Latitude: 39°49'00"N

Longitude: 79°02'40"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Very dark gray, thin-bedded, silty shale occurs below a coal that is 0.4 foot (0.1 m) thick. The coal is believed to represent the rider #2 to the Sewickley. The shale breaks to form platy and splintery fragments. Weathering changes the color of the shale to a light to medium gray.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Composite representing 7.5 feet (2.3 m) of shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	56.80	Quartz	19	Water of plasticity (%)	15.0
TiO ₂	1.03	Mica	56	Drying shrinkage (%)	0.0
Al ₂ O ₃	18.75	Kaolinite	14	Workability:	Short
Fe ₂ O ₃	8.10	Chlorite-		Dry strength:	Poor
MnO	0.18	vermiculite	1	Drying defects:	None
MgO	0.18	Feldspar	1	pH:	6.0
CaO	0.54	Montmo-			
Na ₂ O	0.18	rillonite	2		
K ₂ O	2.94	Calcite	1		
		Pyrophyllite	2		
		Goethite	10		
		Pyrite present			

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Light brown	3	2.5	18.1	32.2	1.77
1900 1038	Light brown	3	5.0	16.0	29.4	1.83
2000 1093	Brown	4	5.0	10.9	21.3	1.95
2100 1149	Dark brown	6.5	7.5	8.8	17.1	1.94
2200 1204	Dark brown	6.5	10.0	7.4	14.4	1.93

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Low plasticity. Poor color.

Potential uses: Grade SW building brick; drain tile.

SOMERSET COUNTY Summit Twp. Meyersdale quad.

Sample number 59-D-19

Location: Stripping operated by the Sanner Bros. Coal Company, located about 5000 feet (1520 m) from the post office in Meyersdale along a bearing of N86W.

Latitude: 39°49'00"N

Longitude: 79°02'40"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Very dark gray, thin-bedded, silty shales occur for a stratigraphic interval of about 10 feet (3 m) above the Sewickley rider #2 coal. Some of the silty shale breaks into platy fragments and is gray, brown, or tan where weathered. Iron stains are common along joint and bedding planes.

Attitude of bedding: Essentially horizontal

Weathering intensity: Negligible

Sampled interval: Composite representing 10 feet (3 m) of shale

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	62.00	Quartz	29	Water of plasticity (%): 16.3
TiO ₂	1.10	Mica	48	Drying shrinkage (%): 0.0
Al ₂ O ₃	18.40	Kaolinite	18	Workability: Short
Fe ₂ O ₃	4.75	Chlorite-		Dry strength: Poor
MnO	0.08	vermiculite	0	Drying defects: None
MgO	0.72	Feldspar	1	pH: 7.1
CaO	0.58	Montmo-		
Na ₂ O	0.18	rillonite	0	
K ₂ O	2.87	Calcite	0	
		Pyrite present		
		Goethite	5	
		Lepidocrocite present		
		Pyrophyllite present		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	20.8	35.6	1.71
982						
1900	Tan	3	2.5	18.6	33.3	1.79
1038						
2000	Brown	5	5.0	8.3	16.9	2.04
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Low plasticity. Abrupt vitrification. No effervescence when treated with HCl.

Potential uses: Grade MW building brick.

SOMERSET COUNTY Summit Twp. Meyersdale quad.

Sample number 59-D-20

Location: Stripping operated by the Sanner Bros. Coal Company, located about 5000 feet (1520 m) from the post office in Meyersdale along a bearing of N86W.

Latitude: 39°49'00"N

Longitude: 79°02'40"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Medium-gray silty claystone occurs stratigraphically above the Redstone coal. Immediately above the claystone is a dark-gray thick bed of silty clay which measures 2 feet (0.6 m). The Pittsburgh coal is 48 inches (122 cm) thick at this locality.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Channel through 4.5 feet (1.4 m) of silty clay and claystone

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	49.30	Quartz	18	Water of plasticity (%): 15.5
TiO ₂	0.84	Mica	59	Drying shrinkage (%): 0.0
Al ₂ O ₃	22.60	Kaolinite	41	Workability: Short
Fe ₂ O ₃	5.30	Chlorite-		Dry strength: Fair
MnO	0.02	vermiculite	0	Drying defects: None
MgO	0.85	Feldspar	1	pH: 3.4

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	0.51	Montmo-	
Na ₂ O	0.27	rillonite	2
K ₂ O	3.07	Calcite	0

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i> °	<i>Hard- ness</i> (Moh's scale)	% <i>Total shk.</i>	% <i>Absorb.</i>	% <i>App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Light brown	3	5.0	19.6	33.9	1.73
982						
1900	Light brown	3	5.0	16.4	29.3	1.79
1038						
2000	--	--	Expanded	--	--	--
1093						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification. No effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

SOMERSET COUNTY Summit Twp. Meyersdale quad.

Sample number 59-D-21

Location: Stripping operated by the Sanner Bros. Coal Company, located about 5000 feet (1520 m) from the post office in Meyersdale along a bearing of N86W.

Latitude: 39°49'00"N

Longitude: 79°02'40"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: A 4-foot (1.2-m) sequence is exposed between two coal riders above the Redstone coal. At the bottom is 0.8 foot (0.2 m) of thin-bedded silty shale containing plant debris. Stratigraphically above this unit is 2.5 feet (0.8 m) of medium-gray claystone. Dark-gray silty shale, 0.7 foot (0.2 m) thick and containing iron stains along fractures and bedding plane, occurs at the top of the sampled interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel through 4 feet (1.2 m) of shale and claystone

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	48.30	Quartz	14	Water of plasticity (%):	14.8
TiO ₂	0.93	Mica	64	Drying shrinkage (%):	0.0
Al ₂ O ₃	21.65	Kaolinite	20	Workability:	Short
Fe ₂ O ₃	4.10	Chlorite-		Dry strength:	Poor
MnO	0.03	vermiculite	1	Drying defects:	None
MgO	0.73	Feldspar	1	pH:	4.4
CaO	0.21	Montmo-			
Na ₂ O	0.25	rillonite	0		
K ₂ O	2.88	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	0.0	25.5	38.8	1.52
982						
1900	Tan	3	0.0	24.4	36.8	1.51
1038						
2000	Tan	3	0.0	21.4	35.2	1.44
1093						
2100	Gray	6	0.0	21.4	30.0	1.40
1149						
2200	Gray	6	0.0	14.6	21.3	1.46
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Low plasticity. Abrupt vitrification. No effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

SOMERSET COUNTY Summit Twp. Meyersdale quad.

Sample number **59-D-22**

Location: Stripping operated by the Sanner Bros. Coal Company, located about 5000 feet (1520 m) from the post office in Meyersdale along a bearing of N86W.

Latitude: 39°49'00"N

Longitude: 79°02'40"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Dark- to medium-gray, silty claystone occurs stratigraphically above the rider #2 to the Redstone coal. Abundant iron staining is present in the upper half of the 4-foot (1.2-m) interval sampled. The claystone breaks into equant to blocky fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel through 4 feet (1.2 m) of claystone

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	63.10	Quartz	30	Water of plasticity (%): 17.3
TiO ₂	1.08	Mica	46	Drying shrinkage (%): 0.0
Al ₂ O ₃	21.10	Kaolinite	23	Workability: Short
Fe ₂ O ₃	2.70	Chlorite-		Dry strength: Fair
MnO	0.013	vermiculite	0	Drying defects: None
MgO	0.53	Feldspar	1	pH: 7.0
CaO	0.34	Montmo-		
Na ₂ O	0.23	rillonite	0	
K ₂ O	2.44	Calcite	0	
		Pyrite	1	
		Goethite	3	
		Pyrophyllite	5	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	16.2	30.1	1.86
982						
1900	Tan	5	7.5	11.5	23.3	2.04
1038						
2000	Light brown	6	10.0	8.6	18.3	2.14
1093						
2100	Brown	7	10.0	5.2	11.6	2.24
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Low plasticity. Fair color. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick.

SOMERSET COUNTY Summit Twp. Meyersdale quad.Sample number **59-D-23**

Location: Stripping operated by the Sanner Bros. Coal Company, located about 5000 feet (1520 m) from the post office in Meyersdale along a bearing of N86W.

Latitude: **39°49'00"N**Longitude: **79°02'40"W**

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Stratigraphic interval sampled occurs above the Pittsburgh coal and consists of: (1) about 6 feet (2 m) of roof shale; (2) 22 feet (7 m) of interbedded shales, silty shales and sandstones, all gray in color; and (3) 9 feet (2.7 m) of very silty shale which grades upward into an underclay. Iron staining is common on joint surfaces and bedding planes throughout the sampled interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Composite representing about 35 feet (11 m) of section

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	57.70	Quartz	22	Water of plasticity (%): 13.5
TiO ₂	1.07	Mica	56	Drying shrinkage (%): 0.0
Al ₂ O ₃	21.00	Kaolinite	22	Workability: Short
Fe ₂ O ₃	5.55	Chlorite-		Dry strength: Poor
MnO	0.085	vermiculite	0	Drying defects: None
MgO	0.93	Feldspar	1	pH: 6.9
CaO	0.31	Montmo-		
Na ₂ O	0.25	rillonite	0	
K ₂ O	3.41	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	21.3	36.3	1.70
982						
1900	Dark tan	4	5.0	16.7	30.8	1.85
1038						
2000	Light brown	5	5.0	13.4	25.9	1.94
1093						
2100	Brown	5	7.5	12.1	23.7	1.96
1149						
2200	Dark brown	6	12.5	3.3	6.6	2.28
1204						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Low plasticity. Poor color. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; drain tile.

SOMERSET COUNTY Summit Twp. Meyersdale quad.

Sample number **59-D-24**

Location: Stripping operated by the Sanner Bros. Coal Company, located about 5000 feet (1520 m) from the post office in Meyersdale along a bearing of N86W.

Latitude: 39°49'00"N

Longitude: 79°02'40"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Gray- to cream-tan, silty, fissile shale occurs in the upper part of the Casselman Formation. This interval is stratigraphically from 2 to 40 feet (6 to 12 m) below the Pittsburgh coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Composite representing 20 feet (6 m) of shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	58.50	Quartz	21	Water of plasticity (%): 16.7
TiO ₂	1.00	Mica	58	Drying shrinkage (%): 2.5
Al ₂ O ₃	19.35	Kaolinite	20	Workability: Short
Fe ₂ O ₃	6.70	Chlorite-		Dry strength: Fair
MnO	0.13	vermiculite	0	Drying defects: None
MgO	0.79	Feldspar	1	pH: 6.4
CaO	0.39	Montmo-		
Na ₂ O	0.18	rillonite	0	
K ₂ O	3.13	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	17.0	29.8	1.75
982						
1900	Light brown	5	7.5	9.7	19.6	2.01
1038						
2000	Brown	5	10.0	8.2	16.7	2.03
1093						
2100	Dark brown	5	10.0	6.1	12.7	2.09
1149						
2200	Brown black	5	10.0	3.8	7.8	2.06
1204						
2300	Dark gray	5	10.0	2.5	5.2	2.06
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Low plasticity. Fair color. Slight effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBA facing brick.

SOMERSET COUNTY Summit Twp. Meyersdale quad.

Sample number 59-D-25

Location: Stripping operated by the Sanner Bros. Coal Company, located about 5000 feet (1520 m) from the post office in Meyersdale along a bearing of N86W.

Latitude: 39°49'00"N

Longitude: 79°02'40"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Underclay to a 1-foot- (0.3-m-) thick, unidentified coal, occurs about 40 to 50 feet (12 to 15 m) below the Pittsburgh coal. The lower 2 feet (0.6 m) of the underclay consists of a blocky, silty claystone, whereas the upper 2 feet (0.6 m) is a plastic clay.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample through 4 feet (1.2 m) of underclay

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	48.50	Quartz	20	Water of plasticity (%)	31.5
TiO ₂	0.80	Mica	62	Drying shrinkage (%)	5.0
Al ₂ O ₃	19.15	Kaolinite	13	Workability:	Plastic
Fe ₂ O ₃	8.86	Chlorite-		Dry strength:	Good
MnO	0.33	vermiculite	0	Drying defects:	None
MgO	0.83	Feldspar	2	pH:	6.9
CaO	3.20	Montmo-			
Na ₂ O	0.17	rillonite	2		
K ₂ O	2.52	Calcite	1		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Light brown	3	7.5	35.2	45.2	1.28
982						
1900	Brown	3	10.0	24.3	36.2	1.49
1038						
2000	Brown	3	12.5	20.7	31.7	1.53
1093						
2100	Dark brown	5	15.0	10.9	18.1	1.66
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: High shrinkage. Abrupt vitrification. No effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

SOMERSET COUNTY Conemaugh Twp. Hooversville quad.

Sample number **68-A-11**

Location: Borrow pit along the north side of an improved road which trends generally northwest-southeast, located about 5700 feet (1740 m) from Thomas Mill along a bearing of N81E.

Latitude: 40°13'41"N

Longitude: 78°58'02"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Gray, silty, fissile to thin-bedded shales are exposed for a stratigraphic interval of 17 feet (5 m) above the floor of the pit. The shale breaks into splintery, platy, flaggy, slabby, and blocky fragments. Numerous nodules up to 1.5 feet (0.5 m) in long dimension occur in the middle portion of this sequence.

Attitude of bedding: Dips about 2 degrees north

Weathering intensity: Moderate

Sampled interval: Composite representing 17 feet (5 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	63.70	Quartz	24	Water of plasticity (%): 19.2
TiO ₂	1.12	Mica	66	Drying shrinkage (%): 2.5
Al ₂ O ₃	20.50	Kaolinite	7	Workability: Plastic
Fe ₂ O ₃	4.60	Chlorite-		Dry strength: Good
MnO	0.04	vermiculite	2	Drying defects: None
MgO	0.76	Feldspar	1	pH: 6.6
CaO	0.24	Montmo-		
Na ₂ O	0.25	rillonite	0	
K ₂ O	3.33	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Tan	3	2.5	13.6	26.6	1.95
982						
1900	Tan	3	2.5	10.7	22.2	2.06
1038						
2000	Light brown	5	5.0	6.4	14.2	2.23
1093						
2100	Brown	6.5	5.0	5.3	11.9	2.25
1149						
2200	Dark brown	6.5	7.5	3.1	7.0	2.29
1204						
2300	Dark gray	7	7.5	2.7	5.9	2.22
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Fair plasticity. Good color. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates.

SOMERSET COUNTY Paint Twp. Windber quad.

Sample number **68-B-10**

Location: M. F. Fetteroff Coal Company, Inc., strip pit, located about 4300 feet (1310 m) from Hillsboro along a bearing of S61E.

Latitude: 40°10'35"N

Longitude: 78°50'36"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium- to very dark gray, fissile to thin-bedded roof shale to the Middle Kittanning coal is exposed for a stratigraphic thickness of 4.5 feet (1.4 m). Iron-encrusted nodules and slickensides are present in moderate amounts in the interval. Thin- to medium-bedded siltstones and sandstones occur above the sampled interval.

Attitude of bedding: Dips 2 degrees northwest

Weathering intensity: Moderate

Sampled interval: Channel through 4.5 feet (1.4 m) of roof shale

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	56.70	Quartz	16	Water of plasticity (%): 17.2
TiO ₂	0.98	Mica	60	Drying shrinkage (%): 0.0
Al ₂ O ₃	21.90	Kaolinite	16	Workability: Short
Fe ₂ O ₃	5.35	Chlorite-		Dry strength: Fair
MnO	0.03	vermiculite	2	Drying defects: None
MgO	0.89	Feldspar	2	pH: 3.9
CaO	0.08	Montmo-		
Na ₂ O	0.16	rillonite	4	
K ₂ O	3.46	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	17.7	32.0	1.81
982						
1900	Tan	3	5.0	13.9	26.6	1.91
1038						
2000	Light brown	4	7.5	9.7	19.4	2.00
1093						
2100	Brown	5	7.5	8.3	16.6	2.01
1149						
2200	Brown gray	6	7.5	7.0	13.6	1.95
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Low plasticity. Abrupt vitrification (2200-2300°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick.

SOMERSET COUNTY Stonycreek Twp. Stoystown quad.Sample number **68-C-6**

Location: Lasky Construction Company coal stripping, located about 3400 feet (1040 m) from Lambertsville along a bearing of N38-1/2E.

Latitude: 40°04'53"N**Longitude:** 78°54'24"W**Geologic unit:** Kittanning Formation, Allegheny Group

Description: Gray to dark-gray, fissile shale grading upward into claystone occurs between the rider coal to the Lower Kittanning coal and the Middle Kittanning coal. Nodules of limestone ranging from about 1/2 inch (1.3 cm) up to 4 inches (11 cm) in long dimension occur from 2.0 feet (0.6 m) to 4.3 feet (1.3 m) above the base of this interval. Plant debris is present in the shale.

Attitude of bedding: Dips 2 degrees northwest**Weathering intensity:** Negligible**Sampled interval:** Channel through 5 feet (1.5 m) of shale and claystone

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	59.70	Quartz	27	Water of plasticity (%)	12.0
TiO ₂	1.07	Mica	42	Drying shrinkage (%)	0.0
Al ₂ O ₃	19.85	Kaolinite	27	Workability:	Short
Fe ₂ O ₃	5.35	Chlorite-		Dry strength:	Poor
MnO	0.08	vermiculite	3	Drying defects:	None
MgO	1.30	Feldspar	1	pH:	5.7
CaO	0.26	Montmo-			
Na ₂ O	0.18	rillonite	0		
K ₂ O	3.22	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Pink	3	0.0	18.3	32.2	1.76
982						
1900	Dark pink	3	2.5	15.4	28.4	1.84
1038						
2000	Dark pink	4	2.5	14.5	26.9	1.86
1093						
2100	Gray	6.5	2.5	13.1	24.3	1.86
1149						
2200	Dark gray	7	5.0	7.4	14.9	2.01
1204						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Low plasticity. Poor color. Slight effervescence when treated with HCl.

Potential uses: Grade SW building brick.

SOMERSET COUNTY Stonycreek Twp. Stoystown quad.

Sample number **68-C-7**

Location: Lasky Construction Company coal stripping, located about 3400 feet (1040 m) from Lambertsville along a bearing of N38-1/2E.

Latitude: 40°04'53"N

Longitude: 78°54'24"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: The interval between the Middle Kittanning and overlying Upper Kittanning(?) coal seams was sampled; it consists of dark-gray silty fissile roof shale containing plant debris, overlain by a gray underclay. The underclay ranges from 0.8 to 1.5 feet (0.2 to 0.5 m) in thickness. The entire interval measures 12 feet (4 m) in thickness. Locally a limestone layer measuring between 0.1 and 0.2 foot (0.03 and 0.06 m) in thickness separates the roof shale from the underclay.

Attitude of bedding: Dips 2 degrees northwest

Weathering intensity: Negligible

Sampled interval: Channel through 8 feet (2.4 m); the entire interval between the coals

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	68.10	Quartz	26	Water of plasticity (%): 18.3
TiO ₂	1.02	Mica	48	Drying shrinkage (%): 0.0
Al ₂ O ₃	19.70	Kaolinite	20	Workability: Short
Fe ₂ O ₃	4.85	Chlorite-		Dry strength: Fair
MnO	0.08	vermiculite	2	Drying defects: None
MgO	1.09	Feldspar	1	pH: 4.2
CaO	0.13	Montmo-		
Na ₂ O	0.18	rillonite	2	
K ₂ O	3.44	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800 982	Tan	3	2.5	16.2	29.1	1.79
1900 1038	Dark tan	4	5.0	11.9	23.2	1.94
2000 1093	Dark tan	6.5	7.5	9.5	19.2	2.02
2100 1149	Gray	7	7.5	1.9	3.9	2.05
2200 1204	Gray	7	10.0	1.3	2.6	2.00
2300 1260	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2000-2100°F). Slight effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick.

SOMERSET COUNTY Stonycreek Twp. Stoystown quad.

Sample number **68-C-8**

Location: Lasky Construction Company coal stripping, located about 3400 feet (1040 m) from Lambertsville along a bearing of N38-1/2E.

Latitude: 40°04'53"N

Longitude: 78°54'24"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Gray claystone occurs for a measured distance of 4 feet (1.2 m) below the rider coal to the Lower Kittanning coal. The claystone is silty in the upper half and becomes more silty and sandy towards the base. Just under the rider coal is a thin (0.1 foot, or 0.03 m) shale which is locally smeared with pyrite.

Attitude of bedding: Dips 2 degrees northwest

Weathering intensity: Negligible

Sampled interval: Channel through 4 feet (1.2 m) of claystone

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	55.50	Quartz	20	Water of plasticity (%):	14.0
TiO ₂	1.15	Mica	50	Drying shrinkage (%):	0.0
Al ₂ O ₃	22.10	Kaolinite	26	Workability:	Short
Fe ₂ O ₃	5.10	Chlorite-		Dry strength:	Poor
MnO	0.02	vermiculite	3	Drying defects:	None
MgO	0.62	Feldspar	1	pH:	3.9
CaO	0.24	Montmo-			
Na ₂ O	0.18	rillonite	0		
K ₂ O	2.52	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	16.8	30.0	1.79
982						
1900	Dark tan	3	2.5	12.8	24.7	1.93
1038						
2000	Dark tan	4	2.5	11.0	22.2	2.01
1093						
2100	Gray	6	5.0	6.0	12.5	2.10
1149						
2200	Gray	6	7.5	6.6	13.4	2.01
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Prominent iron staining. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick.

SOMERSET COUNTY Stonycreek Twp. Stoystown quad.

Sample number 68-C-9

Location: Lasky Construction Company coal stripping, located about 3400 feet (1040 m) from Lambertsville along a bearing of N38-1/2E.

Latitude: 40°04'53"N

Longitude: 78°54'24"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium- to very dark gray, fissile to thin-bedded, silty shale occurs for a stratigraphic interval of 5 feet (1.5 m) above the Lower Kittanning coal. The uppermost 0.8 foot of this interval is represented by a very silty shale containing a thin band (0.01 foot, or 3 mm) of fine-grained sandstone. A thick-bedded silty sandstone is present above the sampled interval.

Attitude of bedding: Dips 2 degrees northwest

Weathering intensity: Unweathered

Sampled interval: Channel through 5 feet (1.5 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	47.70	Quartz	13	Water of plasticity (%)	17.6
TiO ₂	0.98	Mica	61	Drying shrinkage (%)	5.0
Al ₂ O ₃	20.80	Kaolinite	25	Workability:	Short
Fe ₂ O ₃	7.78	Chlorite-		Dry strength:	Good
MnO	0.11	vermiculite	0	Drying defects:	None
MgO	1.12	Feldspar	1	pH:	5.1
CaO	0.23	Montmo-			
Na ₂ O	0.17	rillonite	0		
K ₂ O	2.98	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Pink	3	5.0	22.8	37.9	1.66
1900 1038	Pink	3	5.0	18.7	32.1	1.72
2000 1093	Brown	4	7.5	13.0	23.7	1.82
2100 1149	Brown	5	7.5	14.9	26.0	1.75
2200 1204	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Low plasticity. Abrupt vitrification. Poor color. Slight effervescence when treated with HCl.

Potential uses: Grade SW building brick.

SOMERSET COUNTY Stonycreek Twp. Central City quad.Sample number **68-D-1**

Location: PBS Coal Company stripping, located about 9,000 feet (2740 m) from Reels Corner on a bearing of S6W.

Latitude: 40°01'58"N**Longitude:** 78°49'55"W**Geologic unit:** Freeport Formation, Allegheny Group

Description: Dark-gray to very dark gray, fissile to thin-bedded roof shales to the Upper Kittanning(?) coal occur for a stratigraphic interval of 6.3 feet (1.9 m). Two thin coal seams, measuring 0.2 and 0.4 foot (0.06 and 0.12 m) in thickness, occur within the roof shale interval and are included in the sample. Thin-bedded siltstones occur above the sampled interval.

Attitude of bedding: Dips 4 degrees northwest**Weathering intensity:** Negligible**Sampled interval:** Channel through 6.3 feet (1.9 m) of roof shales**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	33.00	Quartz	13	Water of plasticity (%): 19.4
TiO ₂	0.56	Mica	46	Drying shrinkage (%): 2.5
Al ₂ O ₃	15.75	Kaolinite	34	Workability: Short
Fe ₂ O ₃	9.47	Chlorite-		Dry strength: Poor
MnO	0.10	vermiculite	0	Drying defects: None
MgO	0.82	Feldspar	1	pH: 5.5
CaO	0.49	Montmo-		
Na ₂ O	0.13	rillonite	4	
K ₂ O	2.12	Calcite	1	
		Pyrophyllite	5	
		Goethite	5	
		Pyrite	2	
		Siderite	4	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	5.0	39.1	49.2	1.26
982						
1900	Light brown	2	10.0	31.8	37.7	1.18
1038						
2000	Brown	3	10.0	26.9	32.1	1.19
1093						
2100	Dark brown	3	10.0	24.8	29.5	1.19
1149						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2200	Brown black	4	7.5	21.2	26.1	1.23
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Positive

Remarks: Not suitable for use in vitreous clay products.

Bloating tests (quick-firing):

Crushing characteristics: Angular Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.24	77.4	23.5	Mixture, part overbloated.
1093				
2100	0.53	33.1	55.6	Overbloated, melting.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Potential uses: Marginal raw material for lightweight aggregate (mixture of bloating and nonbloating materials).

SOMERSET COUNTY Stonycreek Twp. Central City quad.

Sample number 68-D-2

Location: PBS Coal Company stripping, located about 9,000 feet (2740 m) from Reels Corner on a bearing of S6W.

Latitude: 40°01'58"N

Longitude: 78°49'55"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Gray silty underclay to the Upper Kittanning coal is present for a stratigraphic interval of 3.2 feet (1.0 m). The underclay contains an abundance of plant imprints, and breaks into lens-shaped fragments.

Attitude of bedding: Dips 4 degrees northwest

Weathering intensity: Unweathered

Sampled interval: Channel through 3.2 feet (1.0 m) of underclay

Chemical analysis:

	%
SiO ₂	66.00
TiO ₂	1.38
Al ₂ O ₃	21.65
Fe ₂ O ₃	1.70
MnO	0.01
MgO	0.83
CaO	0.20
Na ₂ O	0.17
K ₂ O	3.25

Mineralogy (X-ray):

	%
Quartz	34
Mica	40
Kaolinite	24
Chlorite-vermiculite	0
Feldspar	2
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 12.9
Drying shrinkage (%): 0.0
Workability: Short
Dry strength: Fair
Drying defects: None
pH: 5.9

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	2.5	10.1	20.0	1.98
982						
1900	Cream	3	5.0	7.2	16.3	2.25
1038						
2000	Ivory	5	5.0	5.4	11.7	2.18
1093						
2100	Light gray	6	7.5	2.8	6.5	2.29
1149						
2200	Gray	8	10.0	0.6	1.5	2.34
1204						
2300	Gray	8	10.0	0.6	1.4	2.28
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: A stoneware-type clay of good quality. Might be glazed. No etter-
vescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile;
stoneware.

SOMERSET COUNTY Stonycreek Twp. Central City quad.Sample number **68-D-3****Location:** PBS Coal Company stripping, located about 9,000 feet (2740 m) from Reels Corner on a bearing of S6W.**Latitude:** 40°01'58"N**Longitude:** 78°49'55"W**Geologic unit:** Freeport Formation, Allegheny Group**Description:** Gray to medium-gray, silty claystone occurs from 7.5 feet (2.3 m) to 10 feet (3 m) below the Lower Freeport(?) coal. The claystone has a moderate number of plant imprints and slickensides. It breaks to form hackly and rubbly fragments.**Attitude of bedding:** Dips 4 degrees northwest**Weathering intensity:** Slight**Sampled interval:** Channel through 2.5 feet (0.8 m) of claystone**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	58.20	Quartz	24	Water of plasticity (%): 16.5
TiO ₂	0.99	Mica	54	Drying shrinkage (%): 2.5
Al ₂ O ₃	22.70	Kaolinite	20	Workability: Short
Fe ₂ O ₃	3.28	Chlorite-		Dry strength: Fair
MnO	0.02	vermiculite	1	Drying defects: None
MgO	1.18	Feldspar	2	pH: 7.6
CaO	0.61	Montmo-		
Na ₂ O	0.22	rillonite	0	
K ₂ O	4.05	Calcite	1	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Light tan	3	5.0	12.1	23.0	1.91
982						
1900	Tan	5	7.5	6.7	14.4	2.13
1038						
2000	Dark tan	5	10.0	5.9	12.2	2.08
1093						
2100	Gray tan	6	10.0	4.9	10.6	2.18
1149						
2200	Gray	7	10.0	0.9	2.0	2.14
1204						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2300 1260	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Low plasticity. Good color at 1900°F. High effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick; structural facing tile.

SOMERSET COUNTY Stonycreek Twp. Central City quad.

Sample number 68-D-4

Location: PBS Coal Company stripping, located about 9,000 feet (2740 m) from Reels Corner on a bearing of S6W.

Latitude: 40°01'58"N

Longitude: 78°49'55"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Gray, very hard, shaly limestone or limy claystone occurs from 2.5 to 7.5 feet (0.8 to 2.3 m) below the Lower Freeport coal.

Attitude of bedding: Dips 4 degrees northwest

Weathering intensity: Slight

Sampled interval: Composite representing 5 feet (1.5 m) of material

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	50.60	Quartz	16	Water of plasticity (%): 16.7
TiO ₂	0.91	Mica	58	Drying shrinkage (%): 0.0
Al ₂ O ₃	18.35	Kaolinite	18	Workability: Short
Fe ₂ O ₃	3.00	Chlorite-		Dry strength: Fair
MnO	0.05	vermiculite	0	Drying defects: None
MgO	2.23	Feldspar	1	pH: 8.4
CaO	10.05	Montmo-		
Na ₂ O	0.15	rillonite	3	
K ₂ O	2.41	Calcite	5	
		Dolomite	3	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Cream	3	2.5	20.4	34.0	1.67
982						
1900	Cream	3	2.5	19.9	33.0	1.66
1038						
2000	Cream	3	2.5	18.8	31.3	1.67
1093						
2100	Gray green	4	2.5	8.1	15.6	1.92
1149						
2200	--	--	Melted	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: High effervescence when treated with HCl.

Potential uses: Not suitable for use in vitreous clay products.

SOMERSET COUNTY Stonycreek Twp. Central City quad.

Sample number 68-D-5

Location: PBS Coal Company stripping, located about 9,000 feet (2740 m) from Reels Corner on a bearing of S6W.

Latitude: 40°01'58"N

Longitude: 78°49'55"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Dark-gray to gray underclay is exposed from 0 to 2.5 feet (0 to 0.8 m) below the Lower Freeport(?) coal.

Attitude of bedding: Dip 4 degrees northwest

Weathering intensity: Slight

Sampled interval: Channel through 2.5 feet (0.8 m) of underclay

Chemical analysis: Mineralogy (X-ray): Raw properties:

	%		%	
SiO ₂	54.90	Quartz	29	Water of plasticity (%): 21.0
TiO ₂	0.87	Mica	50	Drying shrinkage (%): 2.5
Al ₂ O ₃	17.90	Kaolinite	15	Workability: Plastic
Fe ₂ O ₃	5.20	Chlorite-		Dry strength: Fair
MnO	0.03	vermiculite	0	Drying defects: None
MgO	0.98	Feldspar	2	pH: 3.9

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	0.80	Montmo-	
Na ₂ O	0.14	rillonite	0
K ₂ O	2.66	Calcite	0
		Gypsum	5
		Goethite	2
		Jarosite present	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Dark tan	4	5.0	22.4	36.6	1.62
982						
1900	Light brown	5	5.0	19.5	32.9	1.68
1038						
2000	Brown	5	10.0	14.7	25.6	1.74
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Abrupt vitrification. No effervescence when treated with HCl.

Potential uses: Grade MW building brick.

SOMERSET COUNTY Somerset Twp. Berlin quad.Sample number **69-A-2**

Location: East side of an abandoned strip mine located about 9000 feet (2740 m) due west of Brotherton. The sample site is located about 8300 feet (2530 m) along a bearing of N82W from Brotherton.

Latitude: 39°58'29"N**Longitude:** 78°59'14"W**Geologic unit:** Glenshaw Formation, Conemaugh Group

Description: Medium-gray semifissile shale grading stratigraphically upward into claystone occurs above the Upper Freeport coal. Siderite bands ranging from about 0.15 to 0.5 foot (0.05 to 0.15 m) in thickness are present in the sampled interval. Shale breaks to form platy fragments, whereas claystone forms blocky or rubbly fragments. Flaggy sandstone overlies the sampled interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Composite through 14 stratigraphic feet (4 m) of shale and claystone

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	58.20	Quartz	24	Water of plasticity (%): 16.0
TiO ₂	0.99	Mica	48	Drying shrinkage (%): 0.0
Al ₂ O ₃	21.05	Kaolinite	26	Workability: Short
Fe ₂ O ₃	6.23	Chlorite-		Dry strength: Fair
MnO	0.08	vermiculite	2	Drying defects: None
MgO	1.67	Feldspar	2	pH: 8.2
CaO	0.40	Montmo-		
Na ₂ O	0.18	rillonite	0	
K ₂ O	3.25	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	0.0	15.2	28.9	1.90
982						
1900	Tan	3	0.0	13.0	25.8	1.99
1038						
2000	Brown	5	5.0	6.4	14.2	2.22
1093						
2100	Dark brown	6	5.0	4.8	10.9	2.27
1149						
2200	Dark gray	7	7.5	4.2	9.1	2.16
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Low plasticity. Abrupt vitrification (1900-2000°F).

Potential uses: Grade SW building brick; Type FBA facing brick.

SOMERSET COUNTY Somerset Twp. Berlin quad.

Sample number **69-A-3**

Location: Abandoned mine entry located about 9300 feet (2830 m) along a bearing of N86W from Brotherton.

Latitude: 39°58'25"N

Longitude: 78°59'27"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Medium- to very dark gray, fissile to thickly laminated shales grade upward into slightly silty shales over a stratigraphic interval of 19 feet (6 m). The base of this interval is defined by the Lower Freeport(?) coal. From 11 to 14 feet (3.4 to 4.3 m) above the base, alternating thin-bedded sandstones and silty shales occur.

Attitude of bedding: Essentially horizontal

Weathering intensity: Moderate

Sampled interval: Composite through 19 stratigraphic feet (6 m)

Chemical analysis:

	%
SiO ₂	62.40
TiO ₂	1.12
Al ₂ O ₃	21.35
Fe ₂ O ₃	3.48
MnO	0.03
MgO	1.32
CaO	0.20
Na ₂ O	0.18
K ₂ O	3.14

Mineralogy (X-ray):

	%
Quartz	28
Mica	44
Kaolinite	22
Chlorite-vermiculite	5
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 19.0
 Drying shrinkage (%): 0.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 5.0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	0.0	12.4	24.1	1.95
982						
1900	Tan	3	2.5	8.9	17.9	2.01
1038						
2000	Tan	4	2.5	7.8	16.7	2.14
1093						
2100	Light brown	5	2.5	4.7	10.5	2.25
1149						
2200	Gray	5	2.5	4.8	10.3	2.15
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Low plasticity. Fair color. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick.

SOMERSET COUNTY Somerset Twp. Berlin quad.Sample number **69-A-4**

Location: Abandoned mine entry located about 9300 feet (2830 m) along a bearing of N86W from Brotherton.

Latitude: 39°58'25"N**Longitude:** 78°59'27"W**Geologic unit:** Freeport Formation, Allegheny Group

Description: Medium-gray silty shale occurs between two coals, probably close to the Lower Freeport coal horizon. The upper foot (0.3 m) of the sampled interval is claystone and breaks into hackly fragments. The shale breaks to form platy or papery fragments. The lower coal is 3 feet (0.9 m) thick; the upper coal is 0.5 feet (0.2 m) thick.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight to moderate

Sampled interval: Channel sample through 7-1/2 feet (2.3 m) of shale and claystone

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	58.50	Quartz	22	Water of plasticity (%): 13.0
TiO ₂	1.12	Mica	54	Drying shrinkage (%): 0.0
Al ₂ O ₃	21.20	Kaolinite	18	Workability: Short
Fe ₂ O ₃	5.15	Chlorite-		Dry strength: Poor
MnO	0.06	vermiculite	3	Drying defects: None
MgO	1.46	Feldspar	2	pH: 5.8
CaO	0.19	Montmo-		
Na ₂ O	0.23	rillonite	0	
K ₂ O	3.57	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	0.0	16.0	29.0	1.82
982						
1900	Tan	5	0.0	15.7	28.3	1.80
1038						
2000	Light brown	5	2.5	12.9	23.3	1.81
1093						
2100	Brown	5	5.0	10.1	18.2	1.80
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: Low plasticity. Abrupt vitrification (2100-2200°F).

Potential uses: Grade SW building brick.

SOMERSET COUNTY Brothersvalley Twp. Berlin quad.

Sample number **69-A-6**

Location: Croner Coal Company stripping operation, located about 1 mile (1.6 km) due north of Berlin.

Latitude: 39°56'00"N

Longitude: 78°57'16"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Thirty-nine feet (12 m) of section occurring above the Pittsburgh coal is represented in this sample and consists of the following: 0.8 foot (0.2 m) of roof slate, 0.7 foot (0.2 m) of gray silty limestone; 7.0 feet (2.1 m) of very dark gray, silty shale; 10 feet (3 m) of medium-gray shale and fine-grained sandstone; 19.7 feet (6.0 m) of medium-gray silty shale; and 0.8 foot (0.2 m) of silty claystone.

Attitude of bedding: Dips 1 degree south

Weathering intensity: Unweathered

Sampled interval: Composite representing 39 feet (12 m) of section

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	54.20	Quartz	24	Water of plasticity (%):	20.6
TiO ₂	0.98	Mica	54	Drying shrinkage (%):	0.0
Al ₂ O ₃	17.30	Kaolinite	18	Workability:	Plastic
Fe ₂ O ₃	7.78	Chlorite-		Dry strength:	Good
MnO	0.22	vermiculite	4	Drying defects:	None
MgO	1.56	Feldspar	1	pH:	5.4
CaO	0.42	Montmo-			
Na ₂ O	0.22	rillonite	0		
K ₂ O	2.92	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Light brown	3	0.0	12.5	25.1	1.94

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1900	Light brown	4	2.5	10.3	19.9	2.00
1038						
2000	Brown	5	5.0	7.1	15.5	2.19
1093						
2100	Dark brown	6	10.0	0.3	0.8	2.40
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: NA

Bloating test: Positive

Remarks: Fair plasticity. Abrupt vitrification (2000-2100°F).

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.10	68.4	19.6	Good pore structure.
1093				
2100	0.98	61.2	19.4	Large pores in some lumps.
1149				
2200	0.82	51.2	27.1	Numerous large pores.
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate. Appears to be a mixture of bloating and nonbloating materials.

Potential uses: Grade SW building brick; marginal raw material for lightweight aggregate.

SOMERSET COUNTY Brothersvalley Twp. Berlin quad.Sample number **69-A-7**

Location: Slefco Bros. Coal Company strip pit, located about 5000 feet (1520 m) south-southeast of Shaft.

Latitude: 39°53'42"N**Longitude:** 78°55'30"W**Geologic unit:** Kittanning Formation, Allegheny Group

Description: Medium-gray interbedded shales and siltstones and a few lenses of fine-grained sandstone occur for a stratigraphic interval of 34 feet (10 m) above the Lower Kittanning coal. The upper 12 feet (4 m) of sediments have moderate amounts of iron staining along fractures and bedding planes. The middle third of the sampled interval contains moderate concentrations of nodules ranging from 0.3 to 0.9 foot (0.1 to 0.3 m) in their long dimension.

Attitude of bedding: N40E, 13S**Weathering intensity:** Unweathered**Sampled interval:** Composite representing 34 stratigraphic feet (10 m)**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	64.70	Quartz	24	Water of plasticity (%): 19.6
TiO ₂	1.13	Mica	54	Drying shrinkage (%): 0.0
Al ₂ O ₃	19.70	Kaolinite	19	Workability: Short
Fe ₂ O ₃	5.80	Chlorite-		Dry strength: Fair
MnO	0.06	vermiculite	3	Drying defects: None
MgO	1.37	Feldspar	1	pH: 6.0
CaO	0.18	Montmo-		
Na ₂ O	0.20	rillonite	0	
K ₂ O	3.35	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	0.0	17.2	31.4	1.83
982						
1900	Tan	4	0.0	12.8	25.4	1.99
1038						
2000	Light brown	5	2.5	9.4	19.9	2.11
1093						
2100	Dark brown	5	5.0	1.4	3.3	2.42
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: Low plasticity. Abrupt vitrification (2000-2100°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

SOMERSET COUNTY Brothersvalley Twp. Berlin quad.

Sample number **69-A-8**

Location: Strip pit operated by Leo Ohler, located about 6500 feet (1980 m) from Salco on a bearing of S10W.

Latitude: 39°52'58"N

Longitude: 78°56'40"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Dark-gray underclay to a coal seam which varies from 1 inch (2.5 cm) to 18 inches (46 cm) in thickness. The underclay is 2 feet (0.6 m) thick. It is underlain by 15 feet (5 m) of thin- to medium-bedded silty shale that contains siderite nodules and plant imprints. A poor-quality coal underlies the silty shale. The coals are probably within the zone of the Bakerstown coals.

Attitude of bedding: N30E, 7N

Weathering intensity: Unweathered

Sampled interval: Composite representing 17 stratigraphic feet (5 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	52.10	Quartz	23	Water of plasticity (%): 16.8
TiO ₂	0.95	Mica	50	Drying shrinkage (%): 0.0
Al ₂ O ₃	17.90	Kaolinite	12	Workability: Short
Fe ₂ O ₃	7.42	Chlorite-		Dry strength: Good
MnO	0.14	vermiculite	4	Drying defects: None
MgO	1.76	Feldspar	2	pH: 5.0
CaO	0.40	Montmo-		
Na ₂ O	0.17	rillonite	5	
K ₂ O	2.82	Calcite	0	
		Pyrite	2	
		Pyrophyllite	3	
		Goethite	1	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	4	0.0	22.6	36.9	1.63
982						
1900	Beige	5	0.0	21.3	35.7	1.68
1038						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2000 1093	Light brown	6	2.5	17.5	31.3	1.79
2100 1149	Dark brown	7	7.5	11.3	22.2	1.96
2200 1204	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Low plasticity. Abrupt vitrification (2100-2200°F). No effervescence when treated with HCl.

Potential uses: Grade MW building brick.

SOMERSET COUNTY Brothersvalley Twp. Berlin quad.

Sample number 69-A-9

Location: Strip pit operated by Leo Ohler, located about 6500 feet (1980 m) from Salco on a bearing of S10W.

Latitude: 39°52'58"N

Longitude: 78°56'40"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium- to dark-gray, silty shale occurs stratigraphically above the upper coal described in sample 69-A-8. The silty shale is highly stained with iron along bedding and fracture surfaces. Some siderite nodules occur in the lower 2 feet (0.6 m) of this 15-foot (5-m) interval.

Attitude of bedding: N30E, 7N

Weathering intensity: Moderate

Sampled interval: Composite through 15 feet (5 m)

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

%		%	
SiO ₂	59.40	Quartz	26
TiO ₂	1.06	Mica	54
Al ₂ O ₃	19.95	Kaolinite	11
Fe ₂ O ₃	6.14	Chlorite-	
MnO	0.06	vermiculite	6
MgO	1.86	Feldspar	1
CaO	0.18	Montmo-	
Na ₂ O	0.18	rillonite	2
K ₂ O	3.17	Calcite	0

Water of plasticity (%): 20.4
Drying shrinkage (%): 0.0
Workability: Short
Dry strength: Fair
Drying defects: None
pH: 5.4

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800 982	Tan	3	0.0	16.6	29.7	1.79
1900 1038	Tan	3	2.5	14.4	26.6	1.85
2000 1093	Brown	3	7.5	4.8	10.4	2.19
2100 1149	Brown	4	7.5	0.8	1.9	2.29
2200 1204	Dark brown	7.5	7.5	1.0	2.1	2.14
2300 1260	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Low plasticity. Abrupt vitrification (1900-2000°F). No effervescence when treated with HCl.

Potential uses: Grade SW building brick.

SOMERSET COUNTY Brothersvalley Twp. Berlin quad.

Sample number 69-A-10

Location: Strip pit operated by Leo Ohler, located about 6600 feet (2010 m) from the town of Salco along a bearing of S12W.

Latitude: 39°52'59"N

Longitude: 78°56'45"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Gray, poorly bedded to fissile, silty shale occurs for a stratigraphic interval of 6.5 feet (2.0 m) above a coal. The coal probably belongs in the Bakerstown horizon. The shale is commonly iron stained along bedding and fracture planes. A medium-gray sandstone about 8 inches (20 cm) thick overlies the shale.

Attitude of bedding: N30E, 7N

Weathering intensity: Moderate

Sampled interval: Channel through 6.5 stratigraphic feet (2.0 m) of silty shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	56.20	Quartz	20	Water of plasticity (%): 18.6
TiO ₂	0.89	Mica	56	Drying shrinkage (%): 0.0
Al ₂ O ₃	19.80	Kaolinite	18	Workability: Short
Fe ₂ O ₃	10.08	Chlorite-		Dry strength: Fair
MnO	0.10	vermiculite	5	Drying defects: None
MgO	1.47	Feldspar	1	pH: 4.7
CaO	0.21	Montmo-		
Na ₂ O	0.28	rillonite	0	
K ₂ O	2.90	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	0.0	20.1	34.8	1.73
982						
1900	Tan	3	0.0	16.0	30.4	1.90
1038						
2000	Brown	5	5.0	8.4	18.1	2.14
1093						
2100	Brown	7.5	5.0	6.2	13.7	2.19
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Low plasticity. Fair color. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBA facing brick.

SOMERSET COUNTY Northampton Twp. Fairhope quad.

Sample number **69-D-5**

Location: Borrow pit along the north side of a light-duty road, located about 5300 feet (1620 m) east by road from the cemetery in Johnsborg.

Latitude: 39°52'17"N

Longitude: 78°49'32"W

Geologic unit: Chemung Formation, Devonian age

Description: Olive-gray to dark-greenish-gray, thickly laminated to very thinly bedded silty shales are exposed in the borrow pit, overlying very fine to coarse-grained sandstones. The shales occur in beds ranging from 0.1 inch (0.3 cm) up to 0.4 inch (1 cm) in thickness and break to form splintery, platy, or equant fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Composite through 28 stratigraphic feet (9 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	61.60	Quartz	28	Water of plasticity (%):	14.6
TiO ₂	1.04	Mica	62	Drying shrinkage (%):	0.0
Al ₂ O ₃	19.40	Kaolinite	2	Workability:	Short
Fe ₂ O ₃	6.84	Chlorite-		Dry strength:	Fair
MnO	0.06	vermiculite	1	Drying defects:	None
MgO	1.35	Feldspar	2	pH:	6.3
CaO	0.18	Montmo-			
Na ₂ O	0.48	rillonite	4		
K ₂ O	4.15	Calcite	0		
		Pyrophyllite	2		
		Siderite	1		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	0.0	11.0	22.7	2.06
982						
1900	Tan	4	2.5	9.1	19.2	2.11
1038						
2000	Light brown	5	2.5	7.6	16.6	2.18
1093						
2100	Brown	6	5.0	5.1	11.2	2.21
1149						
2200	Red brown	6	5.0	2.4	5.2	2.18
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Positive

Remarks: No effervescence when treated with HCl. Low plasticity. Fair color.

Bloating tests (quick-firing):

Crushing characteristics: Angular Particle size: -1/2" (1.3 cm) lumps
Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1900	-	--	--	--
1038				
2000	2.15	134.2	3.1	No expansion.
1093				
2100	1.70	106.1	4.4	Slight expansion.
1149				
2200	1.41	87.8	6.1	Fair pore structure.
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for use as raw material for lightweight aggregate (heavy).

Potential uses: Grade SW building brick; Type FBS facing brick.

SOMERSET COUNTY Addison Twp. Accident quad.

Sample number **140-B-1**

Location: Exposure along the northeast side of U.S. Route 40, about 6600 feet (2010 m) southeast by road from the cemetery in the village of Addison.

Latitude: 39°44'21"N

Longitude: 79°19'30"W

Geologic unit: Glenshaw Formation (lowest portion), Conemaugh Group

Description: Light- to dark-gray interbedded shales and silty shales in the lowest part of the Glenshaw Formation are exposed for a stratigraphic distance of 19.5 feet (6 m). An occasional bed of silty sandstone, ranging from 0.1 to 0.2 foot (3 to 6 cm) in thickness, also occurs in the sampled interval. The shale is fissile and breaks to form platy fragments, whereas the silty shale forms chippy to slabby fragments. Some iron staining is present along fractures and bedding planes.

Attitude of bedding: Dips 2 degrees northwest

Weathering intensity: Moderate to slight

Sampled interval: Composite representing 19.5 feet (6 m) of shales and silty shales

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	59.40	Quartz	22	Water of plasticity (%): 15.3
TiO ₂	1.08	Mica	59	Drying shrinkage (%): 0.0
Al ₂ O ₃	20.30	Kaolinite	12	Workability: Short
Fe ₂ O ₃	7.52	Chlorite-		Dry strength: Poor
MnO	0.07	vermiculite	4	Drying defects: None
MgO	1.70	Feldspar	1	pH: 4.8

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	0.09	Montmo-	
Na ₂ O	0.20	rillonite	2
K ₂ O	3.17	Calcite	0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	0.0	18.6	31.3	1.69
982						
1900	Tan	3	0.0	17.6	32.3	1.84
1038						
2000	Brown	5	2.5	10.9	22.2	2.04
1093						
2100	Brown	7.5	2.5	8.9	18.8	2.11
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F). Fair color. No effervescence when treated with HCl.

Potential uses: Grade MW building brick.

WASHINGTON COUNTY Jefferson Twp. Steubenville East quad.

Sample number 0.7-D-1A

Location: Strip mine operated by the Bologna Mining Company located about 19,000 feet (5800 m) east of the high school in Hooverson Heights.

Latitude: 40°19'34"N

Longitude: 80°30'36"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Medium-dark-gray to brown-black, interbedded shaly siltstones and shales occur directly above the Pittsburgh coal for a distance of 6 feet (1.8 m). Sandstone beds lie stratigraphically above the sampled interval. The sampled beds range in thickness from 2 inches to 1 foot (5 cm to 0.3 m). Some pyrite and carbonaceous material occur within the sampled interval.

Attitude of bedding: Horizontal

Weathering intensity: Unweathered

Sampled interval: Channel through 6 stratigraphic feet (1.8 m)

Chemical analysis:

	%
SiO ₂	50.6
TiO ₂	0.96
Al ₂ O ₃	18.3
Fe ₂ O ₃	2.5
FeO	6.8
MnO	0.16
MgO	1.8
CaO	0.38
Na ₂ O	0.32
K ₂ O	3.0
P ₂ O ₅	0.26
S (total)	1.1
C (org.)	5.8
CO ₂	2.9
H ₂ O ⁻	1.0
H ₂ O ⁺	6.6
Volatiles (excl. H ₂ O, CO ₂)	4.2

Mineralogy (X-ray):

	%
Quartz	18
Mica	59
Kaolinite	15
Chlorite- vermiculite	4
Feldspar	4
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	19.3
Drying shrinkage (%):	2.5
Workability:	Plastic
Dry strength:	Poor
Drying defects:	None
pH:	9.0

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Beige	3	2.5	24.9	39.4	1.58
982						
1900	Light brown	3	5.0	20.7	34.7	1.67
1038						
2000	Light brown	4	10.0	14.0	26.3	1.88
1093						
2100	Red brown	4	10.0	13.0	24.4	1.88
1149						
2200	Dark brown	5	10.0	5.8	11.4	1.98
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color at 2100°F; abrupt vitrification at 2100-2200°F.

Potential uses: Grade SW building brick; Type FBS facing brick; drain tile.

WASHINGTON COUNTY Jefferson Twp. Steubenville East quad.Sample number **0.7-D-1B**

Location: Strip mine operated by the Bologna Mining Company located about 19,000 feet (5790 m) east of the high school in Hooverson Heights.

Latitude: 40°19'34"N

Longitude: 80°30'36"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Dark-green-gray underclay to the Pittsburgh coal. Only the upper 6 inches (15.2 cm) of underclay is exposed in the strip pit.

Attitude of bedding: Horizontal

Weathering intensity: Unweathered

Sampled interval: Grab sample of underclay

Chemical analysis:

	%
SiO ₂	55.3
TiO ₂	0.86
Al ₂ O ₃	18.5
Fe ₂ O ₃	4.7
FeO	1.6
MnO	0.03
MgO	1.7
CaO	2.2
Na ₂ O	0.26
K ₂ O	3.8
P ₂ O ₅	1.2
S (total)	2.1
C (org.)	1.7
CO ₂	0.10
H ₂ O ⁻	2.2
H ₂ O ⁺	5.6

Mineralogy (X-ray):

	%
Quartz	21
Mica	76
Kaolinite	0
Chlorite- vermiculite	2
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 18.7
 Drying shrinkage (%): 2.5
 Workability: Plastic
 Dry strength: Fair
 Drying defects: None
 pH: 8.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Dark tan	4	7.5	8.6	17.5	2.03
982						
1900	Light brown	4	10.0	2.8	6.2	2.20
1038						
2000	Light brown	4	10.0	0.9	1.8	2.03
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Marginal color in slow-firing tests; slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.20	74.9	13.4	Laminar expansion.
1038				
2000	1.15	72.0	21.1	Laminar expansion.
1093				
2100	0.76	47.4	25.7	Good pore structure.
1149				
2200	0.54	33.7	31.9	Overbloated. Large pores.
1204				
2300	--	--	--	--
1260				

Potential uses: Grade SW building brick; Type FBA facing brick; preliminary bloating tests indicate it has promise as a raw material for lightweight aggregate.

WASHINGTON COUNTY Hanover Twp. Burgettstown quad.

Sample number 7-A-1

Location: Strip pit operated by the Pennweir Construction Company and located about 8000 feet (2440 m) west of Dinsmore.

Latitude: 40°22'58"N**Longitude:** 80°27'35"W**Geologic unit:** Casselman Formation, Conemaugh Group

Description: Medium-gray to olive-gray underclay to the Pittsburgh coal is exposed in the floor of the pit. The thickness of the underclay was undetermined because the exposure is limited. A grab sample was collected from a small sump in the pit.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Grab sample**Chemical analysis:**

	<i>%</i>
SiO ₂	49.7
TiO ₂	0.83
Al ₂ O ₃	17.0
Fe ₂ O ₃	5.6
FeO	1.0

Mineralogy (X-ray):

	<i>%</i>
Quartz	16
Mica	49
Kaolinite	17
Chlorite-vermiculite	0

Chemical analysis:

	%
MnO	0.03
MgO	1.4
CaO	7.4
Na ₂ O	0.17
K ₂ O	3.0
P ₂ O ₅	0.55
S (total)	3.4
C (org.)	0.33
CO ₂	4.9
H ₂ O ⁻	2.0
H ₂ O ⁺	4.7

Mineralogy (X-ray):

	%
Feldspar	1
Montmorillonite	5
Calcite	8
Pyrite	5

Raw properties:

Water of plasticity (%):	18.8
Drying shrinkage (%):	2.5
Workability:	Plastic
Dry strength:	Fair
Drying defects:	None
pH:	9.0

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	5.0	12.4	24.1	1.94
982						
1900	Tan	4	5.0	12.3	23.9	1.94
1038						
2000	Tan	4	10.0	11.5	22.3	1.93
1093						
2100	Light brown	4	10.0	6.7	13.6	2.02
1149						
2200	--	--	--	--	--	--
1204						
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Fair color at 1900°F. Highly effervescent with HCl.**Potential uses:** Grade SW building brick; Type FBS facing brick.**WASHINGTON COUNTY Smith Twp. Clinton quad.**Sample number **7-B-2A****Location:** Bologna Mining Company strip mine operation located about 7000 feet (2130 m) north of the village of Raccoon.**Latitude:** 40°23'56"N**Longitude:** 80°21'28"W**Geologic unit:** Pittsburgh Formation, Monongahela Group

Description: Underclay to a bony coal seam, the base of the latter occurring from 2 to 3 feet (0.6 to 0.9 m) above the Pittsburgh coal. The gray underclay ranges from 24 to 36 inches (61 to 91 cm) in thickness

Attitude of bedding: Essentially horizontal

Weathering intensity: Very slight

Sampled interval: Channel sample through entire thickness

Chemical analysis:

	%
SiO ₂	55.5
TiO ₂	0.96
Al ₂ O ₃	22.2
Fe ₂ O ₃	2.1
FeO	3.1
MnO	0.07
MgO	1.6
CaO	0.36
Na ₂ O	0.32
K ₂ O	3.2
P ₂ O ₅	0.08
S (total)	0.19
C (org.)	2.3
CO ₂	0.03
H ₂ O ⁻	1.1
H ₂ O ⁺	7.6
Volatiles (excl. H ₂ O, CO ₂)	1.4

Mineralogy (X-ray):

	%
Quartz	23
Mica	38
Kaolinite	32
Chlorite- vermiculite	5
Feldspar	1
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%):	19.0
Drying shrinkage (%):	2.5
Workability:	Plastic
Dry strength:	Fair
Drying defects:	None
pH:	8.9

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	18.3	31.4	1.71
982						
1900	Salmon	3	5.0	15.7	28.2	1.80
1038						
2000	Salmon	3	10.0	10.6	20.9	1.96
1093						
2100	Light brown	4	10.0	6.1	12.9	2.13
1149						
2200	Dark gray	4	12.5	1.9	4.4	2.28
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Slightly effervescent with HCl. Fair color at 2000°F.

Potential uses: Grade SW building brick; Type FBA facing brick.

WASHINGTON COUNTY Smith Twp. Clinton quad.Sample number **7-B-2B****Location:** Bologna Mining Company strip mine operation located about 7000 feet (2130 m) north of the village of Raccoon.**Latitude:** 40°23'56"N**Longitude:** 80°21'28"W**Geologic unit:** Pittsburgh Formation, Monongahela Group**Description:** Olive, brownish-black, and greenish-gray to dark-greenish-gray, medium- to thick-bedded claystones and silty shales occur above the rider to the Pittsburgh coal. Total thickness of this sequence is estimated to be about 35 feet (11 m).**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight to moderate**Sampled interval:** Composite representing 12 stratigraphic feet (4 m)**Chemical analysis:**

	%
SiO ₂	55.6
TiO ₂	1.0
Al ₂ O ₃	18.5
Fe ₂ O ₃	4.4
FeO	5.0
MnO	0.18
MgO	2.0
CaO	0.93
Na ₂ O	0.51
K ₂ O	3.0
P ₂ O ₅	0.23
S (total)	0.61
C (org.)	1.3
CO ₂	2.0
H ₂ O ⁻	0.79
H ₂ O ⁺	5.7
Volatiles (excl. H ₂ O, CO ₂)	none

Mineralogy (X-ray):

	%
Quartz	18
Mica	55
Kaolinite	13
Chlorite- vermiculite	9
Feldspar	4
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%):	18.7
Drying shrinkage (%):	2.5
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	9.0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
800	Tan	3	2.5	19.8	33.4	1.69
982						
900	Light brown	3	5.0	17.6	31.2	1.77
038						
000	Light brown	3	5.0	13.2	25.7	1.94
093						

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
2100	Red brown	4	10.0	5.7	12.4	2.17
1149						
2200	--	--	Expanded	--	--	--
1204						

Potential uses: Grade SW building brick; Type FBS facing brick; drain tile.

Sample number **7-B-2C**

Longitude: 80°21'28"W

Description: Olive-black underclay to the Pittsburgh coal is partially exposed in the floor of the strip mine. The upper 6 inches (15.2 cm) of underclay was collected as a sample.

Attitude of bedding: Essentially horizontal

Weathering intensity: Very slight

Sampled interval: Grab sample from upper 6 inches (15.2 cm)

Chemical analysis:

Mineralogy (X-ray):

	%		%
SiO ₂	56.3	Quartz	26
TiO ₂	0.96	Mica	55
Al ₂ O ₃	20.0	Kaolinite	14
Fe ₂ O ₃	4.5	Chlorite-	
FeO	1.4	vermiculite	4
MnO	0.03	Feldspar	1
MgO	1.3	Montmorillonite	0
CaO	1.4	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.17
K ₂ O	3.3
P ₂ O ₅	0.88
S (total)	2.1
C (org.)	1.7
CO ₂	0.05
H ₂ O ⁻	1.7
H ₂ O ⁺	5.9
Volatiles (excl. H ₂ O, CO ₂)	None

Raw properties:

Water of plasticity (%): 17.2
 Drying shrinkage (%): 5.0
 Workability: Plastic
 Dry strength: Good
 Drying defects: None
 pH: 8.7

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	4	7.5	8.8	19.4	1.99
982						
1900	Tan	4	10.0	5.8	12.4	2.15
1038						
2000	Light brown	4	10.0	3.1	6.9	2.25
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Slightly effervescent with HCl. Fair color at 1800°F in slow-firing tests.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.56	97.5	12.0	No expansion.
1038				
2000	1.50	93.6	13.7	No expansion.
1093				
2100	1.05	65.5	14.1	Good pore structure.
1149				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i>		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
	(gm/cc)	(lb/ft ³)		
2200	0.86	53.4	17.8	Overbloated, sticky.
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBS facing brick; promising lightweight aggregate material.

WASHINGTON COUNTY Robinson Twp. Clinton quad.

Sample number **7-B-3A**

Location: Aloe Coal Company stripping operation on the north side of Pa. Route 980 at McAdams.

Latitude: 40°23'14"N

Longitude: 80°15'57"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Olive to brownish-black and medium- to medium-dark-gray, medium- to massive-bedded claystones and silty shales occur above the rider or roof coal to the Pittsburgh coal bed.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Composite representing 12 stratigraphic feet (4 m)

Chemical analysis:

	<i>%</i>
SiO ₂	52.0
TiO ₂	0.98
Al ₂ O ₃	21.1
Fe ₂ O ₃	3.1
FeO	5.0
MnO	0.09
MgO	1.5
CaO	0.56

Mineralogy (X-ray):

	<i>%</i>
Quartz	17
Mica	60
Kaolinite	16
Chlorite- vermiculite	6
Feldspar	1
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.15
K ₂ O	2.9
P ₂ O ₅	0.25
S (total)	0.38
C (org.)	3.8
CO ₂	0.03
H ₂ O ⁻	1.1
H ₂ O ⁺	7.0
Volatiles (excl. H ₂ O, CO ₂)	4.2

Raw properties:

Water of plasticity (%): 17.5
 Drying shrinkage (%): 2.5
 Workability: Plastic
 Dry strength: Fair
 Drying defects: None
 pH: 9.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	18.0	31.3	1.74
982						
1900	Tan	3	5.0	15.3	28.2	1.84
1038						
2000	Light brown	4	7.5	10.5	21.3	2.03
1093						
2100	Red brown	4	10.0	6.7	14.4	2.15
1149						
2200	Dark brown	5	10.0	3.0	6.6	2.25
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Slightly effervescent with HCl. Fair color at 2100°F.

Potential uses: Grade SW building brick; Type FBS facing brick; Type H floor brick.

WASHINGTON COUNTY Robinson Twp. Clinton quad.Sample number **7-B-3B**

Location: Aloe Coal Company stripping operation on the north side of Pa. Route 980 at McAdams.

Latitude: 40°23'14"N

Longitude: 80°15'57"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Dark-greenish-gray calcareous shale occurs below the Redstone limestone horizon. The shale breaks into hackly fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel sample through 12 stratigraphic feet (4 m)

Chemical analysis:

Mineralogy (X-ray):

	%
SiO ₂	53.4
TiO ₂	0.86
Al ₂ O ₃	19.2
Fe ₂ O ₃	5.3
FeO	1.8
MnO	0.02
MgO	2.1
CaO	3.0
Na ₂ O	0.29
K ₂ O	4.1
P ₂ O ₅	0.17
S (total)	1.3
C (org.)	0.24
CO ₂	2.3
H ₂ O ⁻	2.1
H ₂ O ⁺	5.5
Volatiles (excl. H ₂ O, CO ₂)	None

	%
Quartz	13
Mica	67
Kaolinite	11
Chlorite- vermiculite	2
Feldspar	2
Montmorillonite	0
Calcite	4
Pyrite	1

Raw properties:

Water of plasticity (%):	17.3
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	9.3

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	9.7	19.5	1.99
982						
1900	Light brown	4	10.0	5.7	12.1	2.14
1038						
2000	Light brown	4	10.0	3.6	7.9	2.20
1093						
2100	Red brown	5	10.0	0.4	0.8	2.07
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (1800°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.32	82.4	14.8	Laminar expansion.
1038				
2000	1.25	77.7	15.4	Fair pore structure.
1093				
2100	0.99	61.8	9.0	Good pore structure.
1149				
2200	0.96	59.8	13.0	Good pore structure.
1204				
2300	--	--	--	--
1260				

Recommendations: Rotary kiln test recommended for further evaluation.**ROTARY KILN TEST:****Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	34.6	34.6
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	12.8	47.4
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	23.7	71.1
-.95 cm			
-4 mesh	+8 mesh	28.9	100.0
-8 mesh	PAN	--	--

Fragment shape: Tabular

Crushing loss (-4 mesh): 28.9 percent

Firing data:

Size range of feed: -3/4" (1.9 cm) +4 mesh

Pour weight of feed (lb/ft³): 80.0

Bloating temperature (°F): 2115

(kg/m³): 1281.6

(°C): 1157

Logging temperature, nodules sticking together (°F): 2140

(°C): 1171

Firing data:

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designa- tion</i>	<i>3/4"</i> <i>(1.9 cm)</i>	<i>1/2"</i> <i>(1.3 cm)</i>	<i>3/8"</i> <i>(.95 cm)</i>	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine	Not done							
Coarse								

Fine: --

Coarse: 52.0

Remarks: Not suitable for lightweight aggregate (limy).**Potential uses:** Grade MW building brick; Type FBA facing brick; Type M floor brick.

*ASTM designation C311-59T

WASHINGTON COUNTY North Strabane Twp. Washington East quad.Sample number **18-A-7****Location:** Twilight Industries, Inc., operation on Lindley strip located about 5000 feet (1520 m) south-southwest of Strabane.**Latitude:** 40°14'07"N**Longitude:** 80°12'30"W**Geologic unit:** Pittsburgh Formation, Monongahela Group**Description:** Olive-black claystone, about 25.5 inches (64.8 cm) thick, occurs above the Pittsburgh coal. A massive sandstone bed occurs stratigraphically above the claystone.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Channel through 25.5 inches (64.8 cm) of claystone**Chemical analysis:****Mineralogy (X-ray):**

	%		%
SiO ₂	50.2	Quartz	11
TiO ₂	0.92	Mica	64
Al ₂ O ₃	23.4	Kaolinite	20
Fe ₂ O ₃	2.3	Chlorite-	
FeO	5.2	vermiculite	3
MnO	0.14	Feldspar	1
MgO	1.9	Montmorillonite	1
CaO	0.60	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.18
K ₂ O	3.6
P ₂ O ₅	0.19
S (total)	0.24
C (org.)	2.4
CO ₂	2.0
H ₂ O ⁻	1.2
H ₂ O ⁺	7.2

Raw properties:

Water of plasticity (%): 18.3
 Drying shrinkage (%): 2.5
 Workability: Plastic
 Dry strength: Good
 Drying defects: None
 pH: 8.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	17.1	30.3	1.78
982						
1900	Tan	3	7.5	12.4	24.1	1.94
1038						
2000	Light brown	4	10.0	7.1	15.5	2.18
1093						
2100	Red brown	5	12.5	2.2	5.2	2.32
1149						
2200	Dark brown	6.5	15.0	0.7	0.2	2.30
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
800	--	--	--	--
982				
900	1.68	104.7	10.5	No expansion.
038				
000	1.46	91.1	5.4	No expansion.
093				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2100	0.82	51.2	17.1	Mixed bloated and over-
1149				bloated.
2200	0.47	29.3	43.5	Melted.
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for lightweight aggregate because product consists of mixture of low- and high-temperature bloating materials.

Potential uses: Grade SW building brick; Type M floor brick.

WASHINGTON COUNTY Somerset Twp. Hackett quad.

Sample number **18-B-4**

Location: Twilight Industries, Inc., stripping operation located about 13,000 feet (4000 m) northwest of Bentleyville and between Faithful Green Lake and the Bentleyville Reservoir.

Latitude: 40°09'10"N

Longitude: 80°02'19"W

Geologic unit: Waynesburg Formation, Dunkard Group

Description: Olive-black to medium-dark-gray underclay to the upper seam of the Waynesburg coal is exposed in the stripping. The underclay is 12 inches (30 cm) thick.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through underclay

Chemical analysis:

	<i>%</i>
SiO ₂	58.9
TiO ₂	1.1
Al ₂ O ₃	22.9
Fe ₂ O ₃	2.3
FeO	0.56
MnO	0.00
MgO	0.79
CaO	0.43

Mineralogy (X-ray):

	<i>%</i>
Quartz	26
Mica	59
Kaolinite	15
Chlorite-	
vermiculite	0
Feldspar	0
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.34
K ₂ O	3.1
P ₂ O ₅	0.07
S (total)	1.1
C (org.)	0.65
CO ₂	0.06
H ₂ O ⁻	1.8
H ₂ O ⁺	6.7

Raw properties:

Water of plasticity (%): 16.7
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 8.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	12.7	24.2	1.91
982						
1900	Tan	3	5.0	10.5	21.0	2.00
1038						
2000	Beige	4	10.0	5.0	11.0	2.22
1093						
2100	Gray	5	10.0	1.3	3.0	2.35
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color at 1900°F.

Potential uses: Grade MW building brick; Type FBS facing brick.

WASHINGTON COUNTY Fallowfield Twp. Hackett quad.Sample number **18-B-5**

Location: Twilight Industries, Inc. stripping operation located about 6000 feet (1830 m) south of Ginger Hill.

Latitude: 40°10'46"N

Longitude: 80°00'19"W

Geologic unit: Waynesburg Formation, Dunkard Group

Description: Medium-dark-gray to brownish-black silty claystones, 10 feet (3 m) thick, occur above the Waynesburg coal. Stratigraphically higher, the sequence becomes siltier.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel through 10 feet (3 m) of claystones

Chemical analysis:

	%
SiO ₂	55.0
TiO ₂	0.98
Al ₂ O ₃	20.3
Fe ₂ O ₃	2.5
FeO	4.4
MnO	0.12
MgO	1.8
CaO	0.76
Na ₂ O	0.69
K ₂ O	3.1
P ₂ O ₅	0.21
S (total)	0.57
C (org.)	2.4
CO ₂	1.7
H ₂ O ⁻	0.93
H ₂ O ⁺	6.6

Mineralogy (X-ray):

	%
Quartz	19
Mica	64
Kaolinite	4
Chlorite-vermiculite	9
Feldspar	4
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 18.9
Drying shrinkage (%): 2.5
Workability: Plastic
Dry strength: Good
Drying defects: None
pH: 6.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	17.5	30.5	1.74
982						
1900	Light brown	3	5.0	14.9	27.4	1.84
1038						
2000	Light brown	4	7.5	8.1	16.9	2.07
1093						
2100	Red brown	4	10.0	2.7	6.3	2.29
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.72	107.3	7.9	No expansion.
1038				
2000	1.53	95.5	12.5	No expansion.
1093				
2100	1.02	63.8	15.6	Good pore structure.
1149				
2200	0.69	43.1	27.9	Overbloomed, large pores.
1204				
2300	--	--	--	--
1260				

Recommendations: Rotary kiln test recommended for further evaluation.**ROTARY KILN TEST:****Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	51.1	51.1
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	21.6	72.7
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	23.8	96.5
-.95 cm			
-4 mesh	+8 mesh	1.4	97.9
-8 mesh	PAN	2.1	100.0

Fragment shape: Angular

Crushing loss (-4 mesh): 3.5 percent

Firing data:

Size range of feed: -3/4" (1.9 cm) +4 mesh

Pour weight of feed (lb/ft³): 88.0

Bloating temperature (°F): 2330

(kg/m³): 1409.8

(°C): 1277

Logging temperature, nodules sticking together (°F): 2350

(°C): 1288

Firing data:

Fired material (all fired material crushed through a roll crusher)
Screen analysis* (percentages by weight passing sieves):

Size designa- tion	3/4" (1.9 cm)	1/2" (1.3 cm)	3/8" (.95 cm)	No. 4	No. 8	No. 16	No. 50	No. 100
Fine	Not done							
Coarse								
Fine: --	Coarse: 53.0							

Remarks: Good color at 2100°F in slow-firing tests; not suitable for light-weight aggregate (limy and refractory).
Potential uses: Grade SW building brick; Type H floor brick.

*ASTM designation C311-59T

WASHINGTON COUNTY Fallowfield Twp. Hackett quad.

Sample number 18-B-6

Location: Twilight Industries, Inc., stripping operation located about 7200 feet (2190 m) south of Ginger Hill.

Latitude: 40°10'33"N Longitude: 80°00'16"W

Geologic unit: Uniontown Formation, Monongahela Group

Description: Medium- to medium-dark-gray underclay to the Waynesburg coal is exposed in this stripping. It measures 12 inches (30 cm) in thickness.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample through 12 inches (30 cm) of underclay

Chemical analysis:		Mineralogy (X-ray):	
	%		%
SiO ₂	57.3	Quartz	24
TiO ₂	1.2	Mica	48
Al ₂ O ₃	23.6	Kaolinite	18
Fe ₂ O ₃	2.2	Chlorite-	
FeO	0.64	vermiculite	4
MnO	0.01	Feldspar	1
MgO	0.74	Montmorillonite	5
CaO	0.75	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.29
K ₂ O	2.5
P ₂ O ₅	0.08
S (total)	0.56
C (org.)	1.9
CO ₂	0.07
H ₂ O ⁻	1.8
H ₂ O ⁺	8.0

Raw properties:

Water of plasticity (%): 17.5
 Drying shrinkage (%): 5.0
 Workability: Plastic
 Dry strength: Good
 Drying defects: None
 pH: 7.3

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	16.4	29.6	1.80
982						
1900	Tan	3	5.0	13.0	24.7	1.90
1038						
2000	Tan	4	7.5	8.3	17.2	2.06
1093						
2100	Tan	4	10.0	3.7	8.2	2.22
1149						
2200	Buff	4	10.0	0.2	0.5	2.26
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color at 2000°F. Might be glazed. No effervescence of raw clay with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile.

WASHINGTON COUNTY California Twp. California quad.Sample number **28-C-5**

Location: Stripping operation of Louis Partazana located about 3 miles (4.8 km) southwest of Speers.

Latitude: 40°05'49"N

Longitude: 79°55'30"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Olive-black, thin- to thick-bedded silty claystones interbedded with a few thin beds of medium-grained sandstones. Beds range in thickness from 2 to 17 inches (5.1 to 43 cm). Fragments are platy, slabby, or flaggy, and have angular edges. Sampled interval is immediately above the Pittsburgh coal. Some iron staining occurs along fractures.

Attitude of bedding: Horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel from 0 to 8 feet (0 to 2.4 m) above the coal

Chemical analysis:

	%
SiO ₂	56.6
TiO ₂	0.94
Al ₂ O ₃	19.9
Fe ₂ O ₃	1.5
FeO	4.8
MnO	0.06
MgO	1.6
CaO	0.35
Na ₂ O	0.26
K ₂ O	3.0
P ₂ O ₅	0.14
S (total)	0.08
C (org.)	2.0
CO ₂	1.6
H ₂ O ⁻	0.62
H ₂ O ⁺	5.5
Volatiles (excl. H ₂ O, CO ₂)	2.2

Mineralogy (X-ray):

	%
Quartz	19
Mica	57
Kaolinite	16
Chlorite- vermiculite	7
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	18.1
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	7.0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	3	5.0	21.8	36.9	1.69
982						
1900	Tan	3	5.0	20.6	35.9	1.74
1038						
2000	Light brown	3	5.0	17.1	31.2	1.82
1093						
2100	Red brown	4	5.0	12.0	23.7	1.97
1149						
2200	Dark brown	4	10.0	8.9	18.5	2.08
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). Abrupt vitrification (2200-2300°F).

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.73	108.0	10.2	No expansion.
1038				
2000	1.51	94.2	20.7	Slight laminar expansion.
1093				
2100	1.30	81.1	11.4	Mixed overbloomed and non-bloomed.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for lightweight aggregate because of overbloomed and nonbloomed materials.

Potential uses: Grade SW building brick; Type FBS facing brick; drain tile.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number 28-B-3A

Location: Exposure along Pa. Route 906 on the east side of the Monongahela River, 2.4 miles (3.9 km) south of the Allegheny-Westmoreland County line.

Latitude: 40°10'08"N

Longitude: 79°51'02"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Grayish-red to greenish-gray claystones underlie shales near the base of an exposure which shows an uninterrupted sequence of sediments estimated to be from 100 to 200 feet (30 to 61 m) thick. The claystones are essentially horizontal where sampled and break down to hackly fragments upon exposure to weathering. The exposure shows the sediments were involved in a history of erosion and deposition associated with a meandering stream.

Attitude of bedding: Dips vary due to channel cutout; sampled unit is essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample through 10 stratigraphic feet (3 m)

Chemical analysis:

	%
SiO ₂	44.7
TiO ₂	0.73
Al ₂ O ₃	14.6
Fe ₂ O ₃	3.8
FeO	1.4
MnO	0.22
MgO	2.0
CaO	12.6
Na ₂ O	0.28
K ₂ O	2.2
P ₂ O ₅	0.19
S (total)	0.13
C (org.)	0.13
CO ₂	10.7
H ₂ O ⁻	1.5
H ₂ O ⁺	4.9

Mineralogy (X-ray):

	%
Quartz	20
Mica	71
Kaolinite	0
Chlorite-vermiculite	3
Feldspar	0
Montmorillonite	0
Calcite	6

Raw properties:

Water of plasticity (%): 15.4
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Good
 Drying defects: None
 pH: 9.5

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Beige	3	5.0	20.1	35.4	1.76
982						
1900	Beige	3	5.0	18.0	32.2	1.79
1038						
2000	Beige	3	5.0	18.3	32.6	1.78
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Abrupt vitrification (2000-2100°F). Slightly effervescent with HCl.

Potential uses: Not suitable for use in vitreous clay products.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.Sample number **28-B-3B**

Location: Exposure along Pa. Route 906 on the east side of the Monongahela River, 2.4 miles (3.9 km) south of the Allegheny-Westmoreland County line.

Latitude: 40°10'08"W

Longitude: 79°51'02"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Medium-gray to medium-dark-gray shales and a few silty shales near the basal portion of the sampled interval. Shale breaks down into platy fragments which measure up to 3 inches (7.6 cm) in long dimension. The silty shale breaks into platy to slabby fragments. Brownish iron stains occur along fractures. Carbonized leaves occur in the silty shales.

Attitude of bedding: Variations due to channel filling

Weathering intensity: Slight

Sampled interval: Composite through 10 stratigraphic feet (3 m)

Chemical analysis:

	%
SiO ₂	58.8
TiO ₂	1.0
Al ₂ O ₃	18.0
Fe ₂ O ₃	3.4
FeO	4.1
MnO	0.17
MgO	1.9
CaO	0.58
Na ₂ O	0.72
K ₂ O	2.5
P ₂ O ₅	0.20
S (total)	0.17
C (org.)	0.18
CO ₂	0.30
H ₂ O ⁻	0.81
H ₂ O ⁺	6.5

Mineralogy (X-ray):

	%
Quartz	25
Mica	47
Kaolinite	15
Chlorite- vermiculite	6
Feldspar	7
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 16.5
Drying shrinkage (%): 5.0
Workability: Short
Dry strength: Fair
Drying defects: None
pH: 8.2

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Dark tan	2	5.0	15.8	28.8	1.83
982						
1900	Light brown	3	5.0	14.0	26.6	1.89
1038						
2000	Light brown	3	7.5	11.1	22.2	2.00
1093						
2100	Red brown	3	10.0	3.2	7.5	2.32
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Abrupt vitrification (2000–2100°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):Crushing characteristics: **Platy**

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.31	81.7	14.9	Laminar expansion.
1093				
2100	1.10	68.6	11.0	Fair pore structure.
1149				
2200	0.92	57.4	12.8	Fair pore structure.
1204				
2300	--	--	--	--
1260				

Potential uses: Grade MW building brick; lightweight aggregate.**WESTMORELAND COUNTY Rostraver Twp. Donora quad.**Sample number **28-B-3C****Location:** Exposure along Pa. Route 906 on the east side of the Monongahela River, 2.4 miles (3.9 km) south of the Allegheny-Westmoreland County line.**Latitude:** 40°10'08"N**Longitude:** 79°51'02"W**Geologic unit:** Casselman Formation, Conemaugh Group**Description:** Medium-dark-gray nonsilty shale underlies a coal seam, the latter located about 100 feet (30 m) above road level. An interbedded silty shale and sandstone interval underlies the nonsilty shale, the latter estimated to be about 70 feet (21 m) thick. The shale breaks down into platy fragments having angular edges.**Attitude of bedding:** Variations due to stream channelling**Weathering intensity:** Slight to moderate**Sampled interval:** Grab sample of nonsilty shale

Chemical analysis:

	%
SiO ₂	58.4
TiO ₂	0.98
Al ₂ O ₃	18.6
Fe ₂ O ₃	3.2
FeO	4.4
MnO	0.06
MgO	2.0
CaO	0.62
Na ₂ O	0.44
K ₂ O	3.0
P ₂ O ₅	0.17
S (total)	0.24
C (org.)	1.3
CO ₂	0.97
H ₂ O ⁻	1.0
H ₂ O ⁺	6.3

Mineralogy (X-ray):

	%
Quartz	22
Mica	57
Kaolinite	13
Chlorite- vermiculite	3
Feldspar	5
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	13.5
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	8.4

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	5.0	12.8	24.8	1.94
982						
1900	Tan	4	5.0	11.3	22.6	2.00
1038						
2000	Orange tan	4	5.0	8.4	17.7	2.10
1093						
2100	Red brown	4	7.5	3.2	7.3	2.28
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2100°F. Slightly effervescent with HCl.

Potential uses: Grade SW building brick; Type H floor brick.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.Sample number **28-B-6A**

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Olive-black to dark-greenish-gray underclay to the Pittsburgh coal occurs between depths of 310.2 and 314.5 feet (94.6 and 95.9 m). It slakes upon exposure.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Entire core

Chemical analysis:

	%
SiO ₂	62.3
TiO ₂	0.96
Al ₂ O ₃	21.0
Fe ₂ O ₃	1.4
FeO	1.2
MnO	0.01
MgO	0.98
CaO	0.33
Na ₂ O	0.38
K ₂ O	2.7
P ₂ O ₅	0.09
S (total)	0.22
C (org.)	0.49
CO ₂	0.10
H ₂ O ⁻	1.2
H ₂ O ⁺	5.8
Volatiles (excl. H ₂ O, CO ₂)	0.46

Mineralogy (X-ray):

	%
Quartz	26
Mica	50
Kaolinite	23
Chlorite- vermiculite	0
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	17.2
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	8.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	5.0	12.8	25.0	1.96
982						
1900	Tan	4	5.0	10.8	22.2	2.06
1038						
2000	Tan	4	10.0	7.5	15.9	2.13
1093						
2100	Light brown	5	10.0	4.6	10.0	2.19
1149						
2200	Dark buff	6	10.0	2.6	6.0	2.27
1204						
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: 14 (1398°C)
(2548°F) Bloating test: Negative

Remarks: Might be glazed. No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number 28-B-6B

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Brown-black to dark-gray silty shale occurs between depths of 258.5 and 272.5 feet (78.8 and 83.1 m) in core. Stringers of coal occur locally along bedding; plant fossils and siderite nodules are also present locally. Base of sampled interval is 28 stratigraphic feet (8 m) above the Pittsburgh coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core between 258.5 and 272.5 feet (78.8 and 83.1 m)

Chemical analysis:

Mineralogy (X-ray):

	%
SiO ₂	58.2
TiO ₂	0.94
Al ₂ O ₃	18.2
Fe ₂ O ₃	1.0
FeO	5.6
MnO	0.07
MgO	1.5
CaO	0.40
Na ₂ O	0.70
K ₂ O	2.8
P ₂ O ₅	0.15
S (total)	0.11
C (org.)	4.1
CO ₂	2.1
H ₂ O ⁻	0.43
H ₂ O ⁺	4.5
Volatiles (excl. H ₂ O, CO ₂)	2.5

	%
Quartz	27
Mica	48
Kaolinite	18
Chlorite- vermiculite	2
Feldspar	5
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 16.0
Drying shrinkage (%): 0.0
Workability: Short
Dry strength: Poor
Drying defects: None
pH: 8.4

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Pc.</i>	<i>Bulk density</i> (gm/cc)
1800	Beige	3	2.5	19.1	34.1	1.78
982						
1900	Light brown	3	5.0	17.2	31.7	1.84
1038						
2000	Light brown	3	5.0	14.0	27.2	1.94
1093						
2100	Red brown	4	5.0	9.2	18.7	2.04
1149						
2200	Dark brown	4	10.0	4.5	10.1	2.25
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). No effervescence with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.19	74.3	10.9	Fair pore structure.
1093				
2100	1.17	73.0	12.1	Fair pore structure.
1149				
2200	1.13	70.5	12.0	Fair pore structure.
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate (heavy). Appears to be a mixture.

Potential uses: Grade SW building brick; Type FBS facing brick; drain tile; marginal raw material for lightweight aggregate.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.Sample number **28-B-6C****Location:** Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.**Latitude:** 40°11'03"N**Longitude:** 79°47'20"W**Geologic unit:** Pittsburgh Formation, Monongahela Group**Description:** Dark-gray to medium-gray to olive-gray underclay to the Redstone coal occurs in the core between depths of 226 and 233 feet (69 and 71 m). It becomes gradually calcareous with depth and slakes upon exposure.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Entire core between 226 and 233 feet (69 and 71 m)**Chemical analysis:**

	%
SiO ₂	58.5
TiO ₂	0.86
Al ₂ O ₃	16.8
Fe ₂ O ₃	2.1
FeO	2.4
MnO	0.01
MgO	1.6
CaO	2.6
Na ₂ O	0.67
K ₂ O	3.5
P ₂ O ₅	0.23
S (total)	0.40
C (org.)	0.77
CO ₂	2.5
H ₂ O ⁻	1.8
H ₂ O ⁺	4.3
Volatiles (excl. H ₂ O, CO ₂)	0.65

Mineralogy (X-ray):

	%
Quartz	26
Mica	52
Kaolinite	2
Chlorite- vermiculite	2
Feldspar	4
Montmorillonite	10
Calcite	2
Siderite	1
Pyrite present	

Raw properties:

Water of plasticity (%):	18.0
Drying shrinkage (%):	0.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	8.7

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Orange tan	4	5.0	9.3	19.2	2.07
982						
1900	Light brown	4	7.5	6.0	12.9	2.16
1038						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2000	Light brown	4	10.0	4.1	9.1	2.24
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND **Bloating test:** Positive

Remarks: Poor colors; low plasticity; slight effervescence with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Angular Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.58	98.6	13.9	Slight expansion.
1038				
2000	1.52	94.8	11.5	Slight expansion.
1093				
2100	1.01	63.0	6.4	Good pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate. Appears to be a mixture.

Potential uses: Grade SW building brick; drain tile; marginal raw material for lightweight aggregate.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number 28-B-6D

Location: Pittsburgh Coal Company core hole on the Stewart tract located about one mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Medium-dark-gray to dark-gray, carbonaceous, calcareous claystone occurs between the depths of 187.5 feet and 197.5 feet (57.2 and 60.2 m). It slakes upon exposure. Base of sampled interval is stratigraphically 26.5 feet (8.1 m) above the Redstone coal.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Entire core from 187.5 feet to 197.5 feet (57.2 to 60.2 m)**Chemical analysis:**

	%
SiO ₂	56.3
TiO ₂	0.70
Al ₂ O ₃	16.0
Fe ₂ O ₃	2.6
FeO	1.6
MnO	0.02
MgO	1.8
CaO	5.1
Na ₂ O	0.65
K ₂ O	3.3
P ₂ O ₅	0.24
S (total)	0.74
C (org.)	0.26
CO ₂	4.1
H ₂ O ⁻	3.2
H ₂ O ⁺	2.9
Volatiles (excl. H ₂ O, CO ₂)	0.00

Mineralogy (X-ray):

	%
Quartz	24
Mica	53
Kaolinite	7
Chlorite- vermiculite	0
Feldspar	1
Montmorillonite	10
Calcite	3
Siderite	1
Pyrite present	

Raw properties:

Water of plasticity (%):	19.3
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	8.8

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Orange tan	4	7.5	11.0	21.9	1.99
982						
1900	Light brown	4	7.5	8.5	17.4	2.03
1038						
2000	Light brown	4	10.0	8.5	17.1	2.06
1093						
2100	Dark brown	5	5.0	4.1	8.0	1.95
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: Poor colors. Slightly effervescent with HCl.

Potential uses: Grade SW building brick; drain tile.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number **28-B-6F**

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Dark-greenish-gray to dark-gray calcareous shale occurs from 83.5 to 90.5 feet (25.5 to 27.6 m) in depth. Pyrite is present in places. Limestone occurs stratigraphically above and below the sampled interval. The sampled interval is probably within the Benwood limestone unit.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core between 83.5 and 90.5 feet (25.5 and 27.6 m)

Chemical analysis:

	%
SiO ₂	55.6
TiO ₂	0.76
Al ₂ O ₃	19.2
Fe ₂ O ₃	4.4
FeO	2.2
MnO	0.01
MgO	2.6
CaO	0.93
Na ₂ O	0.83
K ₂ O	4.3
P ₂ O ₅	0.08
S (total)	2.4
C (org.)	0.27
CO ₂	0.52
H ₂ O ⁻	1.3
H ₂ O ⁺	5.0
Volatiles (excl. H ₂ O, CO ₂)	0.68

Mineralogy (X-ray):

	%
Quartz	21
Mica	75
Kaolinite	0
Chlorite- vermiculite	3
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	19.0
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Good
Drying defects:	None
pH:	8.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Orange tan	4	10.0	6.8	14.7	2.16
982						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1900	Light brown	4	10.0	2.7	6.3	2.32
1038						
2000	--	--	Expanded	--	--	--
1093						

Pyrometric cone equivalent: ND Bloating test: Positive

Remarks: Poor colors.

Bloating tests (quick-firing):

Crushing characteristics: Tabular Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	1.55	96.7	6.3	Slight laminar expansion.
1038				
2000	1.45	90.5	4.8	Slight laminar expansion.
1093				
2100	0.65	40.6	7.3	Overbloated, large pores.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate (short range).

Potential uses: Grade SW building brick; drain tile.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number **28-B-6G**

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Dark-green-gray to olive-black, interbedded shales and claystones, some calcareous, occur between the depths of 50.5 to 60.0 feet (15.4 to 18.3 m). Interval is probably somewhere above the Benwood limestone and below the Uniontown coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core from 50.5 to 60.0 feet (15.4 to 18.3 m)

Chemical analysis:

	%
SiO ₂	56.7
TiO ₂	0.81
Al ₂ O ₃	16.7
Fe ₂ O ₃	4.2
FeO	2.6
MnO	0.00
MgO	2.7
CaO	2.1
Na ₂ O	0.88
K ₂ O	3.5
P ₂ O ₅	0.04
S (total)	2.4
C (org.)	0.33
CO ₂	1.3
H ₂ O ⁻	1.3
H ₂ O ⁺	5.1
Volatiles (excl. H ₂ O, CO ₂)	0.60

Mineralogy (X-ray):

	%
Quartz	20
Mica	64
Kaolinite	5
Chlorite- vermiculite	4
Feldspar	6
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%): 17.6
Drying shrinkage (%): 5.0
Workability: Short
Dry strength: Good
Drying defects: None
pH: 8.7

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	4	7.5	11.2	22.7	2.03
982						
1900	Light brown	4	10.0	6.7	14.7	2.21
1038						
2000	Light brown	4	10.0	3.9	9.0	2.27
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor colors. Slightly effervescent with HCl.

Potential uses: Grade SW building brick; drain tile.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.Sample number **28-B-6H****Location:** Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.**Latitude:** 40°11'03"N**Longitude:** 79°47'20"W**Geologic unit:** Glenshaw Formation, Conemaugh Group**Description:** Medium-gray underclay to the Bakerstown coal occurs between the depths of 734.2 and 737.8 feet (223.8 and 224.9 m). A few rootlets are present in the underclay.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Entire core between 734.2 and 737.8 feet (223.8 and 224.9 m)**Chemical analysis:**

	%
SiO ₂	57.6
TiO ₂	1.2
Al ₂ O ₃	20.2
Fe ₂ O ₃	2.5
FeO	3.2
MnO	0.13
MgO	1.7
CaO	0.84
Na ₂ O	0.61
K ₂ O	3.0
P ₂ O ₅	0.14
S (total)	1.4
C (org.)	0.56
CO ₂	0.62
H ₂ O ⁻	1.4
H ₂ O ⁺	6.4
Volatiles (excl. H ₂ O, CO ₂)	0.00

Mineralogy (X-ray):

	%
Quartz	28
Mica	52
Kaolinite	15
Chlorite- vermiculite	0
Feldspar	4
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%): 15.5
 Drying shrinkage (%): 5.0
 Workability: Plastic
 Dry strength: Good
 Drying defects: None
 pH: 8.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	4	5.0	10.6	21.9	2.07
982						
1900	Orange tan	4	7.5	7.2	15.9	2.20
1038						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2000	Light brown	4	10.0	3.2	7.7	2.40
1093						
2100	Dark brown	7	10.0	1.5	3.4	2.28
1149						
2200	--	--	--	--	--	--
1204						
2300	--	--	--	--	--	--
1260						

Pyrometric cone equivalent: 14 (1398°C)
(2548°F) Bloating test: Negative

Remarks: Fair color (1800°F). No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBS facing brick.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number 28-B-61

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-light-gray calcareous claystone containing limestone nodules grades stratigraphically downward into green-gray claystone to mottled gray-red claystone between the depths of 737.8 and 743.3 feet (224.9 and 226.6 m) in the drill hole. A few plant fragments are present in the lower part. Interval is stratigraphically just below the underclay to the Bakerstown coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core from 737.8 to 743.3 feet (224.9 to 226.6 m)

Chemical analysis:

	%
SiO ₂	52.1
TiO ₂	0.91
Al ₂ O ₃	20.1
Fe ₂ O ₃	2.6
FeO	5.2

Mineralogy (X-ray):

	%
Quartz	18
Mica	68
Kaolinite	7
Chlorite- vermiculite	5

Chemical analysis:

	%
MnO	0.08
MgO	1.9
CaO	2.7
Na ₂ O	0.44
K ₂ O	3.2
P ₂ O ₅	0.13
S (total)	0.13
C (org.)	0.02
CO ₂	3.8
H ₂ O ⁻	0.92
H ₂ O ⁺	5.3
Volatiles (excl. H ₂ O, CO ₂)	0.00

Mineralogy (X-ray):

	%
Feldspar	1
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%):	15.8
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	7.8

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	4	5.0	11.5	23.1	2.01
982						
1900	Orange tan	4	10.0	8.1	17.6	2.16
1038						
2000	Light brown	5	10.0	4.4	10.0	2.29
1093						
2100	Red brown	6	12.5	3.3	7.5	2.27
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor colors; low plasticity. No effervescence with HCl.

Potential uses: Grade SW building brick; drain tile.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number 28-B-6J

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Varicolored (medium-green-gray, medium-dark-gray, gray-black, gray-red, gray-green, and dark-gray-green) claystones and shales occur between the depths of 653.5 and 663.5 feet (199.2 and 202.2 m). Interval is probably within the Pittsburgh red beds unit.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core between 653.5 and 663.5 feet (199.2 and 202.2 m)

Chemical analysis:

	%
SiO ₂	62.9
TiO ₂	1.1
Al ₂ O ₃	19.3
Fe ₂ O ₃	2.1
FeO	2.8
MnO	0.00
MgO	1.4
CaO	0.40
Na ₂ O	0.36
K ₂ O	3.0
P ₂ O ₅	0.05
S (total)	0.00
C (org.)	0.08
CO ₂	0.32
H ₂ O ⁻	0.66
H ₂ O ⁺	5.2
Volatiles (excl. H ₂ O, CO ₂)	0.00

Mineralogy (X-ray):

	%
Quartz	30
Mica	56
Kaolinite	3
Chlorite-vermiculite	7
Feldspar	2
Montmorillonite	0
Calcite	2

Raw properties:

Water of plasticity (%):	20.2
Drying shrinkage (%):	5.0
Workability:	Plastic
Dry strength:	Fair
Drying defects:	None
pH:	8.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	15.3	28.6	1.87
982						
1900	Orange tan	4	5.0	12.1	24.0	1.99
1038						
2000	Orange tan	4	7.5	8.1	16.9	2.10
1093						
2100	Red brown	5	10.0	5.5	11.9	2.18
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor color. Slightly effervescent with HCl.

Potential uses: Grade SW building brick; drain tile.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.Sample number **28-B-6K****Location:** Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.**Latitude:** 40°11'03"N**Longitude:** 79°47'20"W**Geologic unit:** Glenshaw Formation, Conemaugh Group**Description:** Medium-gray calcareous claystones containing limestone nodules occur between the depths of 642.5 and 653.6 feet (195.8 and 199.2 m). Interval is probably within the Pittsburgh red beds unit, which is stratigraphically below the Ames limestone.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Entire core from 642.5 to 653.6 feet (195.8 to 199.2 m)**Chemical analysis:**

	%
SiO ₂	49.3
TiO ₂	0.84
Al ₂ O ₃	14.8
Fe ₂ O ₃	0.9
FeO	6.2
MnO	0.12
MgO	2.4
CaO	7.7
Na ₂ O	0.27
K ₂ O	2.1
P ₂ O ₅	0.10
S (total)	0.02
C (org.)	0.01
CO ₂	10.1
H ₂ O ⁻	0.53
H ₂ O ⁺	4.1
Volatiles (excl. H ₂ O, CO ₂)	0.00

Mineralogy (X-ray):

	%
Quartz	26
Mica	54
Kaolinite	15
Chlorite- vermiculite	0
Feldspar	1
Montmorillonite	0
Calcite	4

Raw properties:

Water of plasticity (%):	14.0
Drying shrinkage (%):	2.5
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	8.7

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Tan	4	2.5	21.4	37.4	1.74
1900 1038	Orange tan	4	2.5	21.3	37.1	1.75
2000 1093	Orange tan	5	2.5	20.9	36.7	1.76

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2100	Light brown	5	2.5	18.4	33.0	1.80
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Abrupt vitrification (2100-2200°F). Effervescent with HCl.

Potential uses: Not suitable for use in vitreous clay products.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number 28-B-6L

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-gray-green to medium-gray calcareous claystones occur between the depths of 626.9 and 642.5 feet (191.1 and 195.8 m). Scattered limestone fragments, gray red in color, are present from 2.2 to 3.1 feet (0.7 to 0.9 m) above the base. Interval is probably within the Pittsburgh red beds unit.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core from 626.9 and 642.5 feet (191.1 to 195.8 m)

Chemical analysis:**Mineralogy (X-ray):**

	%		%
SiO ₂	50.8	Quartz	22
TiO ₂	0.79	Mica	49
Al ₂ O ₃	15.0	Kaolinite	0
Fe ₂ O ₃	2.2	Chlorite-	
FeO	2.9	vermiculite	2
MnO	0.04	Feldspar	1
MgO	1.9	Montmorillonite	20
CaO	9.1	Calcite	6
Na ₂ O	0.38	Siderite present	

Chemical analysis:

	%
K ₂ O	2.5
P ₂ O ₅	0.11
S (total)	0.28
C (org.)	0.17
CO ₂	7.7
H ₂ O ⁻	1.3
H ₂ O ⁺	4.3
Volatiles (excl. H ₂ O, CO ₂)	0.00

Raw properties:

Water of plasticity (%): 14.6
Drying shrinkage (%): 5.0
Workability: Short
Dry strength: Fair
Drying defects: None
pH: 8.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	4	5.0	12.1	22.1	1.92
982						
1900	Tan	4	5.0	11.4	22.1	1.94
1038						
2000	Tan	4	7.5	10.8	20.8	1.92
1093						
2100	Light brown	6	7.5	10.8	20.8	1.92
1149						
2200	--	--	Melted	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor colors. Abrupt vitrification (2100-2200°F). Slightly effervescent with HCl.

Potential uses: Grade SW building brick; drain tile.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number 28-B-6M

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Medium-greenish-gray and grayish-red claystones occur between depths of 608.8 and 620.8 feet (185.6 and 189.2 m) in the drill hole. The interval is stratigraphically above the Ames limestone and in the Birmingham shale unit.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core from 608.8 to 620.8 feet (185.6 to 189.2 m)

Chemical analysis:

	%
SiO ₂	57.1
TiO ₂	0.90
Al ₂ O ₃	19.1
Fe ₂ O ₃	3.0
FeO	4.1
MnO	0.02
MgO	2.3
CaO	0.42
Na ₂ O	0.61
K ₂ O	3.3
P ₂ O ₅	0.10
S (total)	0.28
C (org.)	0.13
CO ₂	0.60
H ₂ O ⁻	1.0
H ₂ O ⁺	5.4
Volatiles (excl. H ₂ O, CO ₂)	0.00

Mineralogy (X-ray):

	%
Quartz	20
Mica	65
Kaolinite	8
Chlorite- vermiculite	4
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	14.3
Drying shrinkage (%):	2.5
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	9.8

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	19.6	35.4	1.80
982						
1900	Tan	4	5.0	18.5	33.3	1.80
1038						
2000	Tan	4	5.0	17.6	32.5	1.84
1093						
2100	Dark brown	6.5	10.0	3.5	7.4	2.12
1149						
2200	--	--	Melted	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor colors. Abrupt vitrification (2000-2100°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.48	92.4	7.7	Laminar expansion.
1093				
2100	1.14	71.1	7.6	Good pore structure.
1149				
2200	1.06	66.1	9.3	Good pore structure.
1204				
2300	--	--	--	--
1260				

Recommendations: Promising raw material for lightweight aggregate but should be tested further because small lumps flake badly.

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

Through	Retained on	Weight, percent	Cumulative, percent
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1/2 inch (1.3 cm) in diameter

Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1/2"x1" (1.3x2.5 cm) rods

Pour weight of feed (lb/ft³): 70.0
(kg/m³): 1121.4

Bloating temperature (°F): 2140
(°C): 1171

Logging temperature, nodules sticking together (°F): 2160
(°C): 1182

Firing data:

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designation</i>	<i>3/4"</i> <i>(1.9 cm)</i>	<i>1/2"</i> <i>(1.3 cm)</i>	<i>3/8"</i> <i>(.95 cm)</i>	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine	--	100.0	56.4	23.7	18.2	--	3.6	1.8
Coarse	--	--	--	--	--	--	--	--

Fine: Combined

Coarse: 30.0

Remarks: Promising raw material for lightweight aggregate, but may be necessary to pelletize. Short firing range.

Potential uses: Grade SW building brick; lightweight aggregate.

*ASTM designation C311-59T

WESTMORELAND COUNTY Rostraver Twp. Donora quad.Sample number **28-B-6N**

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N**Longitude:** 79°47'20"W**Geologic unit:** Casselman Formation, Conemaugh Group

Description: Varicolored (light-olive-gray, gray-brown, mottled-purple-red, olive-green, and gray-green) claystones and calcareous claystones occur between the depths of 596.3 and 608.6 feet (181.8 and 185.5 m). Carbonaceous laminae and occasionally limestone nodules occur in the upper part of the sampled interval. Interval is stratigraphically within the Birmingham shale unit.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Entire core from 596.3 to 608.6 feet (181.8 to 185.5 m)**Chemical analysis:****Mineralogy (X-ray):**

	%		%
SiO ₂	45.4	Quartz	17
TiO ₂	0.71	Mica	72
Al ₂ O ₃	15.3	Kaolinite	0
Fe ₂ O ₃	1.9	Chlorite-	
FeO	5.6	vermiculite	5
MnO	0.23	Feldspar	1
MgO	2.1	Montmorillonite	0
CaO	9.4	Calcite	5

Chemical analysis:

	%
Na ₂ O	0.46
K ₂ O	2.4
P ₂ O ₅	0.13
S (total)	0.27
C (org.)	0.03
CO ₂	10.2
H ₂ O ⁻	0.81
H ₂ O ⁺	3.9
Volatiles (excl. H ₂ O, CO ₂)	0.00

Raw properties:

Water of plasticity (%): 15.2
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 8.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	4	5.0	10.5	21.5	2.05
982						
1900	Orange tan	4	7.5	6.4	14.3	2.24
1038						
2000	Light brown	6	10.0	2.5	6.1	2.41
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor colors. Slightly effervescent with HCl.

Potential uses: Grade SW building brick; drain tile.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.Sample number **28-B-60**

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N**Longitude:** 79°47'20"W**Geologic unit:** Casselman Formation, Conemaugh Group

Description: Grayish-red shales occur between the depths of 547.9 and 565.6 feet (167.0 and 172.4 m). Thin bands or nodules of siderite are present at 2 feet (0.6 m) and 11 feet (3.4 m) above the base of this sample. Interval is stratigraphically within the Birmingham shale unit.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Entire core from 547.9 to 565.6 feet (167.0 to 172.4 m) depth

Chemical analysis:

	%
SiO ₂	52.1
TiO ₂	0.81
Al ₂ O ₃	20.2
Fe ₂ O ₃	5.6
FeO	3.4
MnO	0.33
MgO	2.8
CaO	1.6
Na ₂ O	0.68
K ₂ O	3.5
P ₂ O ₅	0.18
S (total)	0.13
C (org.)	0.04
CO ₂	1.5
H ₂ O ⁻	1.0
H ₂ O ⁺	5.3
Volatiles (excl. H ₂ O, CO ₂)	0.0

Mineralogy (X-ray):

	%
Quartz	17
Mica	74
Kaolinite	0
Chlorite- vermiculite	6
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%)	14.8
Drying shrinkage (%)	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	8.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Orange tan	4	5.0	10.2	21.5	2.10
982						
1900	Light brown	4	7.5	6.2	14.1	2.28
1038						
2000	Light brown	6.5	10.0	2.4	6.0	2.45
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor color. Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)	% Absorb.	Remarks
1800	--	--	--
982			

Bloating tests (quick-firing):

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1900	--	--	--	--
1038				
2000	1.67	104.2	7.6	Laminar expansion.
1093				
2100	1.33	82.9	5.2	Laminar expansion.
1149				
2200	1.18	73.6	7.1	Fair pore structure.
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate (heavy).

Potential uses: Grade SW building brick; marginal raw material for lightweight aggregate.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number **28-B-6P**

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Medium-dark-gray to greenish-gray claystone occurs between the depths of 537.3 and 547.9 feet (163.8 and 167.0 m) in the drill hole. Some silt laminations are present in the upper half. Interval is stratigraphically within the Birmingham shale unit.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Entire core between 537.3 and 547.9 feet (163.8 and 167.0 m)

Chemical analysis:

	%
SiO ₂	54.7
TiO ₂	0.91
Al ₂ O ₃	19.8
Fe ₂ O ₃	2.5
FeO	5.9
MnO	0.23
MgO	2.4
CaO	0.61

Mineralogy (X-ray):

	%
Quartz	22
Mica	67
Kaolinite	0
Chlorite-	
vermiculite	8
Feldspar	3
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.68
K ₂ O	3.1
P ₂ O ₅	0.12
S (total)	0.27
C (org.)	0.55
CO ₂	1.4
H ₂ O ⁻	0.83
H ₂ O ⁺	5.7
Volatiles (excl. H ₂ O, CO ₂)	0.0

Raw properties:

Water of plasticity (%): 16.5
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Good
 Drying defects: None
 pH: 8.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	12.7	25.6	2.02
982						
1900	Orange tan	4	7.5	8.8	19.2	2.18
1038						
2000	Light brown	4	10.0	2.5	6.0	2.42
1093						
2100	Red brown	5	10.0	0.6	1.5	2.42
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.72	107.3	7.1	Laminar expansion.
1093				
2100	1.37	85.5	6.3	Laminar expansion.
1149				

Bloating tests (quick-firing):

Temp. (°F) (°C)	Bulk density		% Absorb.	Remarks
	(gm/cc)	(lb/ft ³)		
2200	1.23	76.8	5.7	Fair pore structure.
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate (heavy).

Potential uses: Grade SW building brick; Type L floor brick; marginal raw material for lightweight aggregate.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number **28-B-6Q**

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Grayish-red calcareous claystones occur between the depths of 527.2 and 537.3 feet (160.7 and 163.8 m) in the drill hole. Calcareous nodules are present in the upper 3 feet (0.9 m) and the basal 0.6 feet (0.2 m) of this interval. Interval is probably part of the Birmingham shale unit.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Entire core between 527.2 and 537.3 feet (160.7 and 163.8 m)

Chemical analysis:**Mineralogy (X-ray):**

	%
SiO ₂	43.6
TiO ₂	0.66
Al ₂ O ₃	14.5
Fe ₂ O ₃	5.0
FeO	1.9
MnO	0.31
MgO	1.7
CaO	14.5

	%
Quartz	17
Mica	54
Kaolinite	9
Chlorite-	
vermiculite	1
Feldspar	1
Montmorillonite	10
Calcite	6

Chemical analysis:

	%
Na ₂ O	0.37
K ₂ O	2.3
P ₂ O ₅	0.11
S (total)	0.01
C (org.)	0.02
CO ₂	10.5
H ₂ O ⁻	1.2
H ₂ O ⁺	4.1
Volatiles (excl. H ₂ O, CO ₂)	0.3

Mineralogy (X-ray):

	%
Siderite present	
Dolomite present	
Pyrite present	

Raw properties:

Water of plasticity (%):	13.4
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	9.8

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness (Moh's scale)</i>	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density (gm/cc)</i>
1800	Light brown	3	5.0	22.7	38.6	1.70
982						
1900	Light brown	4	5.0	20.5	36.0	1.76
1038						
2000	Light brown	4	5.0	19.1	33.7	1.77
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor colors. Abrupt vitrification (2000-2100°F). Highly effervescent with HCl.

Potential uses: Not suitable for use in vitreous clay products.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.Sample number **28-B-6R**

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Olive-green claystones, some calcareous, occur in the upper part of the Birmingham shale unit between the depths of 457.4 and 466.2 feet (139.4 and 142.1 m) in the drill hole. Some gray-red mottling is present. Limestone nodules occur from 3.0 to 3.6 feet (0.9 to 1.1 m) below the top of this interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Entire core between 457.4 and 466.2 feet (139.4 and 142.1 m)

Chemical analysis:

Mineralogy (X-ray):

	%
SiO ₂	46.9
TiO ₂	0.79
Al ₂ O ₃	16.5
Fe ₂ O ₃	4.9
FeO	2.5
MnO	0.11
MgO	1.9
CaO	8.3
Na ₂ O	0.41
K ₂ O	3.0
P ₂ O ₅	0.41
S (total)	1.9
C (org.)	0.18
CO ₂	7.0
H ₂ O ⁻	1.4
H ₂ O ⁺	5.0
Volatiles (excl. H ₂ O, CO ₂)	0.0

	%
Quartz	18
Mica	75
Kaolinite	0
Chlorite- vermiculite	2
Feldspar	1
Montmorillonite	0
Calcite	4

Raw properties:

Water of plasticity (%): 11.8
 Drying shrinkage (%): 2.5
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 9.8

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	15.3	29.4	1.92
982						
1900	Tan	4	5.0	14.5	27.6	1.91
1038						
2000	Tan	4	5.0	13.5	26.3	1.95
1093						
2100	Red brown	5	5.0	13.2	24.1	1.82
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor color. Abrupt vitrification (2100–2200°F). Highly effervescent with HCl.

Potential uses: Not suitable for use in vitreous clay products.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number **28-B-6S**

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Grayish-red and light-grayish-green, calcareous claystones, probably within the Birmingham shale unit, occur between the depths of 466.2 and 480.6 feet (142.1 and 146.5 m) in the drill hole. Limestone nodules up to 0.2 to 0.3 feet (0.06 to 0.09 m) in long dimension are scattered throughout this interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Entire core between 466.2 and 480.6 feet (142.1 and 146.5 m)

Chemical analysis:

	%
SiO ₂	40.2
TiO ₂	0.56
Al ₂ O ₃	13.3
Fe ₂ O ₃	3.1
FeO	1.9
MnO	0.15
MgO	3.8
CaO	14.8
Na ₂ O	0.34
K ₂ O	2.6
P ₂ O ₅	0.17
S (total)	0.01
C (org.)	0.13
CO ₂	14.5
H ₂ O ⁻	1.1
H ₂ O ⁺	3.5
Volatiles (excl. H ₂ O, CO ₂)	0.0

Mineralogy (X-ray):

	%
Quartz	15
Mica	57
Kaolinite	0
Chlorite- vermiculite	1
Feldspar	1
Montmorillonite	0
Calcite	26

Raw properties:

Water of plasticity (%): 13.2
 Drying shrinkage (%): 0.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 9.7

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	0.0	24.5	40.5	1.65
982						
1900	Tan	4	2.5	25.2	40.2	1.60
1038						
2000	Tan	4	5.0	23.7	39.0	1.65
1093						
2100	Brown	4	5.0	22.1	35.6	1.61
1149						
2200	--	--	Melted	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor color. Abrupt vitrification (2100-2200°F). Highly effervescent with HCl.

Potential uses: Not suitable for use in vitreous clay products.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number 28-B-6T

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Grayish-red to dark-greenish-gray, interbedded claystones and shales, probably within the Birmingham shale unit, occur between depths of 480.6 and 495.9 feet (146.5 and 151.2 m) in the drill hole. Some mottling of colors is present. Limestone nodules are present from 4 to 8 feet (1.2 to 2.4 m) above the base of the unit.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Entire core from 480.6 to 495.9 feet (146.5 to 151.2 m)

Chemical analysis:

	%
SiO ₂	58.5
TiO ₂	0.96
Al ₂ O ₃	19.2
Fe ₂ O ₃	3.0
FeO	4.0
MnO	0.03
MgO	1.8
CaO	1.1
Na ₂ O	0.41
K ₂ O	2.8
P ₂ O ₅	0.28
S (total)	0.01
C (org.)	0.09
CO ₂	1.1
H ₂ O ⁻	0.64
H ₂ O ⁺	5.5
Volatiles (excl. H ₂ O, CO ₂)	0.0

Mineralogy (X-ray):

	%
Quartz	23
Mica	66
Kaolinite	0
Chlorite- vermiculite	7
Feldspar	4
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	17.2
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	9.7

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Orange tan	3	5.0	12.7	25.6	2.01
982						
1900	Orange tan	4	5.0	10.4	21.6	2.08
1038						
2000	Light brown	4	10.0	5.8	13.0	2.26
1093						
2100	Dark brown	5	10.0	3.2	7.4	2.27
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor color. Slightly effervescent with HCl.

Potential uses: Grade SW building brick; drain tile.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.Sample number **28-B-6U**

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Dark-gray Brush Creek shale containing siderite and occasionally marine and plant fossils occurs between the depths of 853 and 863 feet (260 and 263 m) in the drill hole.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Entire core between 853 and 863 feet (260 to 263 m)

Chemical analysis:

	%
SiO ₂	49.2
TiO ₂	0.8
Al ₂ O ₃	20.6
Fe ₂ O ₃	2.9
FeO	6.1
MnO	0.09
MgO	2.5
CaO	1.5
Na ₂ O	0.38
K ₂ O	3.5
P ₂ O ₅	0.28
S (total)	1.7
C (org.)	1.2
CO ₂	2.5
H ₂ O ⁻	0.79
H ₂ O ⁺	6.0
Volatiles (excl. H ₂ O, CO ₂)	0.60

Mineralogy (X-ray):

	%
Quartz	18
Mica	73
Kaolinite	0
Chlorite- vermiculite	8
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	16.0
Drying shrinkage (%):	0.0
Workability:	Short
Dry strength:	Poor
Drying defects:	None
pH:	9.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Orange tan	3	5.0	11.7	24.1	2.05
982						
1900	Light brown	4	7.5	7.8	17.4	2.23
1038						
2000	Dark brown	4	12.5	2.6	6.3	2.44
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Poor color. Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
1800	--	--	--	--
982				
1900	1.22	76.3	11.6	Fair pore structure.
1038				
2000	0.81	50.5	12.4	Good pore structure.
1093				
2100	0.44	27.5	39.0	Overbloated. Large pores.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Recommendations: Promising raw material for lightweight aggregate; should be tested further.

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	Crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh		
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1/2 inch (1.3 cm) in diameter

Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1/2"x1" (1.3x2.6 cm) rods

Pour weight of feed (lb/ft³): 70.0
(kg/m³): 1121.4

Bloating temperature (°F): 1930
(°C): 1054

Logging temperature, nodules sticking together (°F): 1970
(°C): 1077

Firing data:

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designa- tion</i>	<i>1/2" (1.3 cm)</i>	<i>3/8" (.95 cm)</i>	<i>No. 4</i>	<i>No. 8</i>	<i>No. 16</i>	<i>No. 50</i>	<i>No. 100</i>
Fine and coarse	100.0	60.9	32.7	24.0	--	4.4	2.2

Fine: Combined

Coarse: 25.0

Remarks: Promising raw material for lightweight aggregate but may be necessary to pelletize. Short firing range.**Potential uses:** Grade SW building brick; drain tile; lightweight aggregate.

*ASTM designation C311-59T

WESTMORELAND COUNTY Rostraver Twp. Donora quad.Sample number **28-B-6V****Location:** Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.**Latitude:** 40°11'03"N**Longitude:** 79°47'20"W**Geologic unit:** Casselman Formation, Conemaugh Group**Description:** Medium-gray thin-bedded silty shales within the Birmingham shale unit occur below the grayish-red shales collected as sample 28-B-6O. Silty shale beds reach a maximum thickness of 1/4 inch (0.6 cm).**Attitude of bedding:** Essentially horizontal**Weathering intensity:** Unweathered**Sampled interval:** Entire core from 565.6 to 568.6 feet (172.4 to 173.3 m)**Chemical analysis:****Mineralogy (X-ray):**

	%
SiO ₂	63.2
TiO ₂	0.86
Al ₂ O ₃	17.7
Fe ₂ O ₃	1.6
FeO	4.0
MnO	0.04
MgO	1.9
CaO	0.42

	%
Quartz	31
Mica	52
Kaolinite	0
Chlorite-	
vermiculite	11
Feldspar	6
Montmorillonite	0
Calcite	0

Chemical analysis:

	%
Na ₂ O	0.90
K ₂ O	2.6
P ₂ O ₅	0.20
S (total)	0.03
C (org.)	0.71
CO ₂	0.35
H ₂ O ⁻	0.45
H ₂ O ⁺	4.6
Volatiles (excl. H ₂ O, CO ₂)	0.0

Raw properties:

Water of plasticity (%): 15.8
 Drying shrinkage (%): 0.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 9.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	15.6	29.5	1.88
982						
1900	Tan	4	2.5	13.3	26.2	1.96
1038						
2000	Orange tan	4	5.0	9.9	20.7	2.09
1093						
2100	Dark red	5	5.0	5.4	11.8	2.16
1149						
2200	Dark brown	6.5	7.5	3.0	6.8	2.28
1204						
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.78	111.1	5.5	No expansion.
1093				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2100	1.40	87.4	8.8	Slight expansion.
1149				
2200	1.14	71.1	5.4	Good pore structure.
1204				
2300	--	--	--	--
1260				

Remarks: Marginal raw material for lightweight aggregate (heavy).

Potential uses: Grade SW building brick; Type FBS facing brick; sewer pipe; liner plates; marginal raw material for lightweight aggregate.

WESTMORELAND COUNTY Rostraver Twp. Donora quad.

Sample number **28-B-6W**

Location: Pittsburgh Coal Company core hole on the Stewart tract located about 1 mile (1.6 km) northeast of Sweeneys Crossroads.

Latitude: 40°11'03"N

Longitude: 79°47'20"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Medium- to dark-gray claystones which grade stratigraphically down into silty shales occur between depths of 157.6 and 166.1 feet (48.0 and 50.6 m). The sampled interval probably lies somewhere above the Sewickley coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: Unweathered

Sampled interval: Entire core between 157.6 and 166.1 feet (48.0 and 50.6 m)

Chemical analysis:**Mineralogy (X-ray):**

	<i>%</i>		<i>%</i>
SiO ₂	62.0	Quartz	35
TiO ₂	0.94	Mica	54
Al ₂ O ₃	16.6	Kaolinite	0
Fe ₂ O ₃	2.2	Chlorite-	
FeO	4.0	vermiculite	5
MnO	0.02	Feldspar	6
MgO	2.1	Montmorillonite	0
CaO	0.41	Calcite	0

Chemical analysis:

	%
Na ₂ O	1.2
K ₂ O	3.2
P ₂ O ₅	0.12
S (total)	0.84
C (org.)	1.1
CO ₂	0.45
H ₂ O ⁻	0.66
H ₂ O ⁺	4.1
Volatiles (excl. H ₂ O, CO ₂)	1.4

Raw properties:

Water of plasticity (%): 17.6
 Drying shrinkage (%): 0.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 9.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	0.0	17.6	32.4	1.84
982						
1900	Orange tan	4	2.5	15.3	28.9	1.89
1038						
2000	Light brown	4	5.0	10.7	21.8	2.04
1093						
2100	Red brown	4	5.0	6.3	13.0	2.06
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color (2100°F). Slightly effervescent with HCl.

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	--	--	--	--
982				
1900	--	--	--	--
1038				
2000	1.55	96.7	13.7	Slight expansion.
1093				
2100	1.22	76.1	18.9	Fair pore structure.
1149				

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2200	0.76	47.6	22.5	Good pore structure.
1204				
2300	--	--	--	--
1260				

Recommendations: Promising raw material for lightweight aggregate; should be tested further.

ROTARY KILN TEST:**Raw material:**

Screen analysis (crushed through a hammermill with 1-1/2" (3.8 cm) screen):

<i>Through</i>	<i>Retained on</i>	<i>Weight, percent</i>	<i>Cumulative, percent</i>
-3/4"	+1/2"	--	--
-1.9 cm	+1.3 cm		
-1/2"	+3/8"	--	--
-1.3 cm	+.95 cm		
-3/8"	+4 mesh	Sample crushed through 4 mesh for extrusion.	
-.95 cm			
-4 mesh	+8 mesh	--	--
-8 mesh	PAN	--	--

Fragment shape: Extruded rods 1/2 inch (1.3 cm) in diameter Crushing loss (-4 mesh): None

Firing data:

Size range of feed: 1/2" (1.3 cm) to 1" (2.5 cm) rods

Pour weight of feed (lb/ft³): 70.0 Bloating temperature (°F): 2040
(kg/m³): 1121.4 (°C): 1116

Logging temperature, nodules sticking together (°F): 2100
(°C): 1149

Fired material (all fired material crushed through a roll crusher)

Screen analysis* (percentages by weight passing sieves):

<i>Size designation</i>	<i>1/2"</i> (1.3 cm)	<i>3/8"</i> (.95 cm)	<i>No.</i> <i>4</i>	<i>No.</i> <i>8</i>	<i>No.</i> <i>16</i>	<i>No.</i> <i>50</i>	<i>No.</i> <i>100</i>
Fine and Coarse	100.0	58.5	24.2	18.5	--	2.8	1.4

Fine: Combined

Coarse: 38.0

*ASTM designation C311-59T

Remarks: Promising raw material for lightweight aggregate but may be necessary to pelletize.

Potential uses: Grade SW building brick; drain tile; lightweight aggregate.

WESTMORELAND COUNTY Lower Burrell Twp. New Kensington quad.

Sample number 36-C-1

Location: Pennsylvania Department of Transportation drill hole #6 at LR 64007, Br 5, Station 136 + 65, 50 feet (15 m) right of the center line. The hole is located about 3000 feet (910 m) southeast of Edgecliff.

Latitude: 40°35'40"N

Longitude: 79°42'54"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Greenish-gray to dark-greenish-gray shale was penetrated between depths of 8 and 18 feet (2.4 and 5.5 m). It is calcareous in the lower part of the sampled interval. Stratigraphically the shale is probably within the lower 50 feet (15 m) of the Glenshaw Formation.

Attitude of bedding: Essentially horizontal; dip is less than 2 degrees to south-southeast

Weathering intensity: Slight

Sampled interval: Entire core between depths of 8 and 18 feet (2.4 and 5.5 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	53.20	Quartz	19	Water of plasticity (%): 19.2
TiO ₂	0.93	Mica	68	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.25	Kaolinite	10	Workability: Short
Fe ₂ O ₃	9.00	Chlorite-		Dry strength: Fair
MnO	0.12	vermiculite	0	Drying defects: None
MgO	1.75	Feldspar	2	pH: 8.4
CaO	3.04	Montmo-		
Na ₂ O	0.13	rillonite	0	
K ₂ O	3.61	Calcite	2	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Tan	3	7.5	13.5	26.5	1.96

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1900	Orange tan	3	7.5	12.3	25.0	2.04
1038						
2000	Light brown	5	10.0	10.5	21.7	2.07
1093						
2100	Medium brown	5	10.0	8.0	17.5	2.19
1149						
2200	Dark brown	7	10.0	0.0	0.0	2.14
1204						
2300	--	--	Melted	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Positive

Remarks: Poor colors in slow-firing tests.

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	1.92	119.8	6.0	No expansion.
982				
1900	1.64	102.3	12.9	Laminar expansion.
1038				
2000	1.47	91.7	3.8	Laminar expansion.
1093				
2100	1.25	78.0	4.1	Good pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe; promising raw material for lightweight aggregate.

WESTMORELAND COUNTY Allegheny Twp. Vandergrift quad.
Sample number **36-D-3**

Location: Pennsylvania Department of Transportation drill boring #3B at LR 188-9, Pine Run, Station 18 + 64, 19 feet (6 m) left of the center line. Located about 4000 feet (1220 m) west of Vandergrift.
Latitude: 40°36'04"N **Longitude:** 79°35'29"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Underclay to the Upper Freeport(?) coal was penetrated between the depths of 10.3 and 13 feet (3.1 and 4 m). The underclay contains a moderate amount of carbonaceous debris.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core between the depths of 10.3 and 13 feet (3.1 and 4 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	48.80	Quartz	14	Water of plasticity (%)	20.5
TiO ₂	1.15	Mica	64	Drying shrinkage (%)	5.0
Al ₂ O ₃	21.25	Kaolinite	20	Workability:	Plastic
Fe ₂ O ₃	5.00	Chlorite-		Dry strength:	Fair
MnO	0.01	vermiculite	0	Drying defects:	None
MgO	0.69	Feldspar	1	pH:	3.8
CaO	0.26	Montmo-			
Na ₂ O	0.16	rillonite	0		
K ₂ O	2.37	Calcite	1		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	7.5	22.1	37.0	1.68
982						
1900	Orange tan	3	7.5	20.9	35.9	1.72
1038						
2000	Red tan	5	10.0	16.1	29.7	1.85
1093						
2100	Dark tan	5	10.0	12.3	25.0	2.03
1149						
2200	Gray brown	6.5	10.0	7.4	15.2	2.06
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Fair color at 2100°F.

Potential uses: Grade SW building brick; Type FBX facing brick.

WESTMORELAND COUNTY Franklin Twp. Murrys ville quad.

Sample number **37-A-1**

Location: Pennsylvania Department of Transportation drill boring #1, LR 64089, Station 459.03, 36 feet (11 m) right of the center line.

Latitude: 40°26'27"N

Longitude: 79°41'25"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Greenish-gray to medium-gray, noncalcareous shale was penetrated in the upper part of the hole. Stratigraphically the shale probably belongs in the lower 50 feet (15 m) of the Glenshaw Formation.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire 5 feet (1.5 m) of shale in core

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	58.40	Quartz	28	Water of plasticity (%): 18.3
TiO ₂	1.16	Mica	51	Drying shrinkage (%): 5.0
Al ₂ O ₃	20.35	Kaolinite	16	Workability: Plastic
Fe ₂ O ₃	6.48	Chlorite-		Dry strength: Fair
MnO	0.03	vermiculite	3	Drying defects: None
MgO	1.12	Feldspar	2	pH: 6.9
CaO	0.42	Montmo-		
Na ₂ O	0.18	rillonite	0	
K ₂ O	3.68	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	15.5	29.1	1.87
982						
1900	Tan	3	7.5	13.8	26.8	1.95
1038						
2000	Tan	5	7.5	11.8	24.0	2.04
1093						
2100	Orange tan	5	10.0	8.9	19.4	2.19
1149						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2200	Light brown	7	10.0	5.2	11.8	2.26
1204						
2300	Gray	7	10.0	1.3	2.8	2.24
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Poor colors.

Potential uses: Grade SW building brick; Type FBA facing brick.

WESTMORELAND COUNTY Sewickley Twp. Smithton quad.

Sample number 38-A-5

Location: Strip pit operated by the Gerry Ridge Coal Company, located about 4000 feet (1220 m) northwest of Yukon.

Latitude: 40°13'23"N

Longitude: 79°41'56"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Medium-gray to olive-black claystones occur above the Redstone coal for a stratigraphic distance of 25 feet (8 m). Bedding is moderately well developed in the claystone; beds average between 1 to 2 feet (0.3 to 0.6 m) in thickness.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample through the basal 10 feet (3 m) of claystone

Chemical analysis:

Mineralogy (X-ray):

	%		%
SiO ₂	51.4	Quartz	19
TiO ₂	0.92	Mica	64
Al ₂ O ₃	20.6	Kaolinite	5
Fe ₂ O ₃	3.6	Chlorite-	
FeO	5.9	vermiculite	9
MnO	0.20	Feldspar	3
MgO	2.0	Montmorillonite	0
CaO	0.73	Calcite	0

Chemical analysis:

	%
Na ₂ O	0.46
K ₂ O	3.1
P ₂ O ₅	0.16
S (total)	1.2
C (org.)	1.5
CO ₂	2.8
H ₂ O ⁻	0.81
H ₂ O ⁺	6.5

Raw properties:

Water of plasticity (%): 14.2
Drying shrinkage (%): 2.5
Workability: Short
Dry strength: Poor
Drying defects: None
pH: 8.1

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	15.3	28.9	1.89
982						
1900	Tan	3	5.0	12.9	25.5	1.99
1038						
2000	Light brown	4	5.0	9.5	20.0	2.12
1093						
2100	Red brown	6	10.0	1.4	3.2	2.38
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Poor colors.

Potential uses: Grade SW building brick; Type FBA facing brick; Type M floor brick.

WESTMORELAND COUNTY East Huntingdon Mount Pleasant
 Twp. quad.

Sample number 38-B-1

Location: Strip pit operated by Marsolino Coal Coke Incorporated, located about 3,000 feet (910 m) southeast of Tarrs.

Latitude: 40°09'56"N Longitude: 79°35'09"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Medium-gray to medium-dark-gray, fissile shale occurs for a distance of 11 feet (3.4 m) stratigraphically above the Redstone coal. Stratigraphically above the shale the lithology becomes siltier to sandy and the beds become thin bedded, measuring from 2.5 to 4 inches (6.4 to 10.2 cm) in thickness.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight to moderate

Sampled interval: Channel through 11 feet (3.4 m) of shale above the Redstone coal

Chemical analysis:

	%
S O ₂	54.7
Ti O ₂	1.0
Al ₂ O ₃	19.8
Fe ₂ O ₃	3.0
FeO	4.4
MnO	0.08
MgO	2.0
CaO	0.92
Na ₂ O	0.18
K ₂ O	3.1
P ₂ O ₅	0.14
S (total)	1.1
C (org.)	0.21
CO ₂	2.3
H ₂ O ⁺	1.1
H ₂ O ⁻	6.5

Mineralogy (X-ray):

	%
Quartz	29
Mica	42
Kaolinite	27
Chlorite-vermiculite	1
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 14.6
Drying shrinkage (%): 2.5
Workability: Short
Dry strength: Poor
Drying defects: None
pH: 7.7

Slow-firing tests:

Temp. (F. C.)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	12.7	24.9	1.95
982						
1900	Orange tan	3	2.5	10.4	21.4	2.05
1038						
2000	Light brown	4	5.0	8.1	17.3	2.14
1093						
2100	Medium brown	4	10.0	2.9	6.7	2.30
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor colors. Slightly effervescent with HCl.

Potential uses: Grade SW building brick; Type FBA facing brick.

WESTMORELAND COUNTY East Huntingdon Mount Pleasant
Twp. quad.

Sample number 38-B-2B

Location: Strip mine operated by Paul W. Kendi, located about 5000 feet (1520 m) southeast of Alverton in the village of Alice.

Latitude: 40°08'02"N

Longitude: 79°34'18"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Olive-black shale unit, 45 inches (114 cm) thick, occurs above the Sewickley coal. Shale is easily broken up into small, angular fragments that are predominantly platy.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample through 45 inches (114 cm)

Chemical analysis:

	%
SiO ₂	57.4
TiO ₂	1.0
Al ₂ O ₃	20.0
Fe ₂ O ₃	4.5
FeO	0.68
MnO	0.01
MgO	1.3
CaO	0.74
Na ₂ O	0.14
K ₂ O	5.0
P ₂ O ₅	0.06
S (total)	2.9
C (org.)	0.40
CO ₂	0.08
H ₂ O ⁻	1.9
H ₂ O ⁺	5.6

Mineralogy (X-ray):

	%
Quartz	29
Mica	61
Kaolinite	9
Chlorite-	
vermiculite	0
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%):	15.2
Drying shrinkage (%):	2.5
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	7.6

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Beige	3	5.0	9.9	19.0	1.93

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1900	Beige	4	10.0	7.5	16.1	2.13
1038						
2000	Light brown	5	10.0	5.4	12.2	2.27
1093						
2100	--	--	Expanded	--	--	--
1149						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 1800°F.

Potential uses: Grade SW building brick; Type FBS facing brick.

WESTMORELAND COUNTY Unity Twp. Mount Pleasant quad.

Sample number 38-B-3A

Location: Strip pit operated by William Piccolomini, located about 700 feet (210 m) north of the church in Brinkerton.

Latitude: 40°13'32"N

Longitude: 79°31'12"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Medium- to medium-dark-gray underclay to the Redstone coal is exposed in this pit. Thickness of the underclay is unknown because its bottom contact is not exposed. A grab sample was collected from the upper 24-inch (61-cm) portion of underclay. Light-brown iron staining occurs along fracture surfaces.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Upper 24 inches (61 cm)

Chemical analysis:

Mineralogy (X-ray):

	%		%
SiO ₂	54.2	Quartz	20
TiO ₂	0.74	Mica	48
Al ₂ O ₃	16.6	Kaolinite	12
Fe ₂ O ₃	2.3	Chlorite-	
FeO	1.2	vermiculite	0

Chemical analysis:

	%
MnO	0.03
MgO	1.6
CaO	7.2
Na ₂ O	0.12
K ₂ O	3.0
P ₂ O ₅	0.38
S (total)	0.78
C (org.)	0.29
CO ₂	5.4
H ₂ O ⁻	1.6
H ₂ O ⁺	5.0

Mineralogy (X-ray):

	%
Feldspar	4
Montmorillonite	10
Calcite	4
Siderite present	
Pyrite present	

Raw properties:

Water of plasticity (%):	18.5
Drying shrinkage (%):	2.5
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	8.0

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	15.6	28.5	1.83
982						
1900	Tan	3	2.5	15.1	27.8	1.83
1038						
2000	Tan	3	2.5	15.1	27.6	1.83
1093						
2100	Brown	6	7.5	0.7	1.7	2.23
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 1800°F.

Potential uses: Grade MW building brick.

WESTMORELAND COUNTY Unity Twp. Mount Pleasant quad.

Sample number 38-B-3B

Location: Strip pit operated by William Piccolomini, located about 700 feet (210 m) north of the church in Brickerton.

Latitude: 40°13'32"N

Longitude: 79°31'12"W

Geologic unit: Pittsburgh Formation, Monongahela Group

Description: Medium-dark-gray to dark-gray claystones grade stratigraphically upward into shales over a distance of 8.5 feet (2.6 m) above the Redstone coal. The lower 3 feet (0.9 m) of the sampled interval contains layers or bands of siderite, ranging from 1.5 to 3 inches (3.8 to 7.6 cm) in thickness. The claystone commonly breaks into hackly fragments; the shale into platy fragments.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample through 8.5 feet (2.6 m)

Chemical analysis:

	%
SiO ₂	55.6
TiO ₂	1.0
Al ₂ O ₃	20.5
Fe ₂ O ₃	2.6
FeO	4.0
MnO	0.07
MgO	2.1
CaO	1.1
Na ₂ O	0.07
K ₂ O	3.2
P ₂ O ₅	0.17
S (total)	0.36
C (org.)	1.2
CO ₂	2.1
H ₂ O ⁻	1.0
H ₂ O ⁺	6.4

Mineralogy (X-ray):

	%
Quartz	23
Mica	62
Kaolinite	5
Chlorite-vermiculite	7
Feldspar	3
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 17.0
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Good
 Drying defects: None
 pH: 7.9

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	13.5	25.7	1.91
982						
1900	Salmon	4	5.0	10.3	21.0	2.04
1038						
2000	Light brown	4	7.5	7.0	15.3	2.18
1093						
2100	Dark brown	7.5	10.0	2.3	5.4	2.34
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 1800°F. Slightly effervescent with HCl.

Potential uses: Grade MW building brick; Type FBA facing brick.

WESTMORELAND COUNTY **Mount Pleasant** **Mount Pleasant**
 Twp. **quad.**

Sample number **38-B-4**

Location: Strip pit operated by Walter Green, Inc., located on the north side of Pa. Route 31 at Mellingtontown.

Latitude: 40°08'42"N

Longitude: 79°30'57"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Medium-gray underclay to the Pittsburgh coal is exposed for a stratigraphic interval of 45 inches (114 cm). The total thickness of the underclay is not known because its bottom contact is not exposed.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample through 45 inches (114 cm) of underclay

Chemical analysis:

	%
SiO ₂	58.8
TiO ₂	0.94
Al ₂ O ₃	24.0
Fe ₂ O ₃	1.2
FeO	0.92
MnO	0.09
MgO	0.98
CaO	0.35
Na ₂ O	0.06
K ₂ O	3.3
P ₂ O ₅	0.22
S (total)	0.14
C (org.)	0.74
CO ₂	0.02
H ₂ O ⁻	1.4
H ₂ O ⁺	7.4

Mineralogy (X-ray):

	%
Quartz	21
Mica	48
Kaolinite	28
Chlorite-	
vermiculite	0
Feldspar	1
Montmorillonite	1
Calcite	1

Raw properties:

Water of plasticity (%): 17.4
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Fair
 Drying defects: None
 pH: 4.9

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	5.0	14.7	27.7	1.88
982						
1900	Cream	3	5.0	12.6	24.4	1.94
1038						
2000	Beige	5	7.5	10.0	20.3	2.03
1093						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2100	Tan	6	7.5	7.9	16.7	2.11
1149						
2200	Buff	7	10.0	5.1	11.3	2.21
1204						
2300	Gray	7	10.0	3.8	8.3	2.19
1260						

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Good color and physical properties at 2100°F. Might be glazed. No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick; facing tile.

WESTMORELAND COUNTY Salem Twp. Saltsburg quad.

Sample number 47-A-3

Location: Pennsylvania Department of Transportation drill hole #1 at LR 64054, Station 234 + 12, 25 feet (8 m) left of the center line. Hole located southwest of point where Whitethorn Creek passes under U.S. Route 22.

Latitude: 40°23'47"N

Longitude: 79°28'52"W

Geologic unit: Casselman Formation, Conemaugh Group

Description: Dark-greenish-gray to medium-gray silty shale occurs for a stratigraphic interval of 5 feet (1.5 m) in the core. A few calcareous blebs are scattered throughout the shale. Stratigraphically, the sampled interval probably belongs in or near the Birmingham shale unit in the lower part of the Casselman Formation.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire 5 feet (1.5 m) of cored shale

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	59.50	Quartz	20	Water of plasticity (%)	19.0
TiO ₂	1.02	Mica	49	Drying shrinkage (%)	2.5
Al ₂ O ₃	19.05	Kaolinite	11	Workability:	Short
Fe ₂ O ₃	7.92	Chlorite-		Dry strength:	Poor
MnO	0.10	vermiculite	13	Drying defects:	None
MgO	2.66	Feldspar	6	pH:	8.1
CaO	0.57	Montmo-			
Na ₂ O	1.18	rillonite	0		
K ₂ O	2.82	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Beige	2	2.5	16.8	30.6	1.82
1900 1038	Orange tan	3	5.0	15.7	29.3	1.87
2000 1093	Light brown	3	5.0	12.2	24.3	1.99
2100 1149	Red brown	4	10.0	7.1	15.3	2.15
2200 1204	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND Bloating test: Positive

Remarks: Fair color in slow-firing test at 2100°F. Abrupt vitrification at 2100-2200°F. May be limy.

Bloating tests (quick-firing):

Crushing characteristics: Tabular Particle size: -3/4" (1.9 cm) lumps
Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800 982	2.07	129.2	8.4	No expansion.
1900 1038	1.95	121.6	8.3	No expansion.
2000 1093	1.31	81.7	10.1	Fair pore structure.

Bloating tests (quick-firing):

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>%</i> <i>Absorb.</i>	<i>Remarks</i>
2100	0.76	47.4	12.4	Overbloated; large pores.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBA facing brick; promising raw material for lightweight aggregate.

WESTMORELAND COUNTY Derry Twp. Blairsville quad.

Sample number **47-B-3I**

Location: Rochester and Pittsburgh Coal Company drill hole, located about 300 feet (90 m) east of Stony Run and about 11,000 feet (3350 m) west-southwest of the village of Brenizer.

Latitude: 40°23'30"N

Longitude: 79°18'31"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-dark-gray calcareous claystone was penetrated between the depths of 326 and 336 feet (99 and 102 m) in the drill hole. The claystone is stratigraphically beneath the Harlem coal. Limestone blebs are common in the claystone; pyrite is rare.

Attitude of bedding: Essentially horizontal

Weathering intensity: None

Sampled interval: Entire interval of core between 326 and 336 feet (99 and 102 m)

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	<i>%</i>		<i>%</i>	
SiO ₂	49.90	Quartz	22	Water of plasticity (%): 17.0
TiO ₂	0.80	Mica	62	Drying shrinkage (%): 2.5
Al ₂ O ₃	16.15	Kaolinite	2	Workability: Short
Fe ₂ O ₃	5.78	Chlorite-		Dry strength: Poor
MnO	0.09	vermiculite	2	Drying defects: None
MgO	2.50	Feldspar	3	pH: 7.7

Chemical analysis:		Mineralogy (X-ray):	
	%		%
CaO	8.30	Montmo-	
Na ₂ O	0.43	rillonite	5
K ₂ O	2.94	Calcite	4
		Pyrite present	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Tan	3	5.0	19.3	33.3	1.73
1900 1038	Tan	3	5.0	16.7	30.8	1.85
2000 1093	Light brown	5	10.0	13.4	26.0	1.95
2100 1149	Light brown	6	10.0	7.7	16.2	2.10
2200 1204	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Poor colors. May be limy.

Potential uses: Grade SW building brick.

WESTMORELAND COUNTY Derry Twp. Blairsville quad.

Sample number 47-B-3K

Location: Rochester and Pittsburgh Coal Company drill hole, located about 300 feet (90 m) east of Stony Run and about 11,000 feet (3350 m) west-southwest of the village of Brenizer.

Latitude: 40°23'30"N

Longitude: 79°18'31"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Grayish-red, dark-reddish-brown, and dark-grayish-green claystones were penetrated between depths of 336 and 350 feet (102 and 107 m) in the drill hole. Stratigraphically, this interval starts about 10 feet (3 m) below the Harlem coal. The claystone in the upper part of this interval is slightly calcareous.

Attitude of bedding: Essentially horizontal

Weathering intensity: None

Sampled interval: Entire core between depths of 336 and 350 feet (102 and 107 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	53.00	Quartz	22	Water of plasticity (%): 16.4	
TiO ₂	0.90	Mica	67	Drying shrinkage (%): 5.0	
Al ₂ O ₃	18.55	Kaolinite	5	Workability: Short	
Fe ₂ O ₃	6.15	Chlorite-		Dry strength: Fair	
MnO	0.06	vermiculite	1	Drying defects: None	
MgO	2.12	Feldspar	2	pH: 9.2	
CaO	5.23	Montmo-			
Na ₂ O	0.45	rillonite	0		
K ₂ O	3.09	Calcite	3		

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800 982	Orange tan	4	5.0	13.6	26.1	1.91
1900 1038	Orange tan	4	7.5	13.8	26.3	1.91
2000 1093	Light brown	5	7.5	12.2	23.7	1.93
2100 1149	Chocolate brown	6	10.0	8.5	16.7	1.97
2200 1204	—	--	Expanded	--	--	--

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Poor colors in slow-firing tests. Abrupt vitrification (2100-2200°F).

Potential uses: Grade SW building brick; drain tile.

WESTMORELAND COUNTY Derry Twp. Blairsville quad.

Sample number **47-B-3L**

Location: Rochester and Pittsburgh Coal Company drill hole, located about 300 feet (90 m) east of Stony Run and about 11,000 feet (3350 m) west-southwest of the village of Brenizer.

Latitude: 40°23'30"N

Longitude: 79°18'31"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Six feet (1.8 m) of grayish-red, very thin to thin-bedded shales overlie one foot (0.3 m) of yellowish-gray claystone between depths of 378 and 385 feet (115 and 117 m) in the drill hole. The change between these two types of sediments is gradational. Some mottling occurs in the claystone. Stratigraphically, this interval is about 52 feet (16 m) below the Harlem coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: None

Sampled interval: Entire core between 378 and 385 feet (115 and 117 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	49.30	Quartz	9	Water of plasticity (%):	14.0
TiO ₂	0.83	Mica	80	Drying shrinkage (%):	5.0
Al ₂ O ₃	21.10	Kaolinite	8	Workability:	Short
Fe ₂ O ₃	11.50	Chlorite-		Dry strength:	Poor
MnO	0.42	vermiculite	3	Drying defects:	None
MgO	1.77	Feldspar	1	pH:	10.1
CaO	0.76	Montmo-			
Na ₂ O	0.41	rillonite	0		
K ₂ O	3.74	Calcite	0		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800 982	Tan	4	5.0	12.4	25.0	2.02
1900 1038	Orange tan	4	5.0	8.9	19.2	2.17
2000 1093	Light brown	5	10.0	6.9	15.6	2.25
2100 1149	Red brown	6	10.0	5.3	12.0	2.27
2200 1204	Dark brown	8	10.0	3.5	8.1	2.32
2300 1260	--	--	Expanded	--	--	

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Low plasticity. Poor colors.

Potential uses: Grade SW building brick; sewer pipe; liner plates.

WESTMORELAND COUNTY Derry Twp. Blairsville quad.Sample number **47-B-3M**

Location: Rochester and Pittsburgh Coal Company drill hole, located about 300 feet (90 m) east of Stony Run and about 11,000 feet (3350 m) west-southwest of the village of Brenizer.

Latitude: 40°23'30"N**Longitude:** 79°18'31"W**Geologic unit:** Glenshaw Formation, Conemaugh Group

Description: Grayish-green to medium-dark-gray claystones occur between depths of 385 and 394.4 feet (117 and 120.2 m) in the drill hole. Limestone blebs and inclusions occur toward the base of this interval. Stratigraphically, this interval occurs about 59 feet (18 m) below the Harlem coal.

Attitude of bedding: Essentially horizontal**Weathering intensity:** None**Sampled interval:** Entire core between 385 and 394.4 feet (117 and 120.2 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	53.90	Quartz	16	Water of plasticity (%)	13.8
TiO ₂	1.06	Mica	67	Drying shrinkage (%)	2.5
Al ₂ O ₃	19.80	Kaolinite	2	Workability	Short
Fe ₂ O ₃	6.00	Chlorite-		Dry strength	Poor
MnO	0.15	vermiculite	1	Drying defects	None
MgO	1.83	Feldspar	1	pH	9.8
CaO	4.26	Montmo-			
Na ₂ O	0.44	rillonite	5		
K ₂ O	3.27	Calcite	3		
		Siderite	1		

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Tan	3	5.0	14.0	26.9	1.92
982						
1900	Tan	3	5.0	11.7	23.4	2.00
1038						
2000	Light brown	5	10.0	4.8	10.9	2.24
1093						
2100	Dark brown	6	10.0	4.3	9.6	1.16
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND**Bloating test:** Negative

Remarks: Poor colors.

Potential uses: Grade SW building brick.

WESTMORELAND COUNTY Derry Twp. Blairsville quad.

Sample number **47-B-3N**

Location: Rochester and Pittsburgh Coal Company drill hole, located about 300 feet (90 m) east of Stony Run and about 11,000 feet (3350 m) west-southwest of the village of Brenizer.

Latitude: 40°23'30"N

Longitude: 79°18'31"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Medium-dark-gray to dark-gray shales and silty shales were penetrated between depths of 444.5 and 459.5 feet (135.5 and 140.0 m). All shales are either thin or thickly laminated; the laminations range from less than 1/32 inch (0.1 cm) to about 1/4 inch (0.6 cm) in thickness. Some mottling of colors occurs in the lower 11 feet (3 m). The interval is stratigraphically in or close to the Pine Creek unit.

Attitude of bedding: Essentially horizontal

Weathering intensity: None

Sampled interval: Entire core between depths of 444.5 and 459.5 feet (135.5 and 140.1 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	59.20	Quartz	22	Water of plasticity (%): 16.2
TiO ₂	1.04	Mica	56	Drying shrinkage (%): 5.0
Al ₂ O ₃	18.75	Kaolinite	14	Workability: Short
Fe ₂ O ₃	7.48	Chlorite-		Dry strength: Poor
MnO	0.06	vermiculite	3	Drying defects: None
MgO	1.67	Feldspar	3	pH: 9.6
CaO	0.46	Montmo-		
Na ₂ O	0.50	rillonite	0	
K ₂ O	3.17	Calcite	1	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	4	5.0	14.0	27.6	1.97
982						
1900	Orange tan	4	5.0	12.4	25.3	2.03
1038						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2000 1093	Light brown	5	10.0	7.9	16.9	2.14
2100 1149	Red brown	6	10.0	3.9	9.1	2.30
2200 1204	Dark brown	7	10.0	1.3	2.9	2.28
2300 1260	--	--	Expanded	--	--	--

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 2100°F.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe.

WESTMORELAND COUNTY Derry Twp. Blairsville quad.

Sample number 47-B-30

Location: Rochester and Pittsburgh Coal Company drill hole, located about 300 feet (90 m) east of Stony Run and about 11,000 feet (3350 m) west-southwest of the village of Brenizer.

Latitude: 40°23'30"N

Longitude: 79°18'31"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Dark-gray, slightly silty shales, grading down into olive-gray claystones and then into olive-gray shaly siltstones, were penetrated between depths of 459.5 and 467.5 feet (140.1 and 142.5 m). Minor mottling is present in the silty shale unit in the upper part of the sampled interval. Stratigraphically, this interval probably lies between the Pine Creek and Brush Creek units.

Attitude of bedding: Essentially horizontal

Weathering intensity: None

Sampled interval: Entire core between depths of 459.5 and 467.5 feet (140.1 and 142.5 m)

Chemical analysis:

	%
SiO ₂	61.10
TiO ₂	1.05
Al ₂ O ₃	17.30
Fe ₂ O ₃	5.70
MnO	0.05
MgO	1.22
CaO	1.13
Na ₂ O	0.29
K ₂ O	2.52

Mineralogy (X-ray):

	%
Quartz	30
Mica	42
Kaolinite	24
Chlorite-vermiculite	2
Feldspar	1
Montmorillonite	0
Calcite	1

Raw properties:

Water of plasticity (%): 16.2
 Drying shrinkage (%): 5.0
 Workability: Short
 Dry strength: Poor
 Drying defects: None
 pH: 9.0

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Beige	4	5.0	14.4	27.6	1.92
982						
1900	Tan	4	5.0	13.9	27.1	1.94
1038						
2000	Orange tan	5	5.0	13.8	27.1	1.96
1093						
2100	Light brown	5	7.5	10.6	21.5	2.04
1149						
2200	Dark brown	7	10.0	6.1	13.3	2.20
1204						
2300	Gray brown	8	10.0	2.4	5.3	2.16
1260						

Pyrometric cone equivalent: ND**Bloating test:** Negative**Remarks:** Good color at 1800°F.**Potential uses:** Grade SW building brick; Type FBA facing brick.**WESTMORELAND COUNTY Derry Twp. Blairsville quad.**Sample number **47-B-3P**

Location: Rochester and Pittsburgh Coal Company drill hole, located about 300 feet (90 m) east of Stony Run and about 11,000 feet (3350 m) west-southwest of the village of Brenizer.

Latitude: 40°23'30"N**Longitude:** 79°18'31"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Greenish-gray, thinly laminated to very thinly bedded, silty clay laminae and shales occur between depths of 472.9 and 484 feet (144.1 and 148 m) in the drill hole. The silt content decreases with depth. Stratigraphically this interval probably lies between the Pine Creek and Brush Creek units.

Attitude of bedding: Essentially horizontal

Weathering intensity: None

Sampled interval: Entire core between depths of 472.9 and 484 feet (144.1 and 148 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:
	%		%	
SiO ₂	53.40	Quartz	22	Water of plasticity (%): 18.4
TiO ₂	1.02	Mica	66	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.20	Kaolinite	5	Workability: Short
Fe ₂ O ₃	8.72	Chlorite-		Dry strength: Poor
MnO	0.10	vermiculite	6	Drying defects: None
MgO	2.00	Feldspar	2	pH: 10.4
CaO	0.69	Montmo-		
Na ₂ O	0.29	rillonite	0	
K ₂ O	3.25	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	4	5.0	14.6	27.4	1.88
982						
1900	Orange tan	4	5.0	12.1	24.0	1.99
1038						
2000	Light brown	6	10.0	9.4	19.7	2.10
1093						
2100	Red brown	6	10.0	4.6	10.6	2.29
1149						
2200	Dark brown	8	10.0	1.3	3.1	2.34
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Good color at 2100°F.

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	2.18	136.0	5.0	No expansion.
982				
1900	2.03	126.6	6.6	No expansion.
1038				
2000	1.76	109.8	6.5	Laminar expansion.
1093				
2100	0.99	61.7	6.6	Fair pore structure.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.**Potential uses:** Grade SW building brick; Type FBS facing brick; Type M floor brick; promising raw material for lightweight aggregate.**WESTMORELAND COUNTY Derry Twp. Blairsville quad.**

Sample number 47-B-3R

Location: Rochester and Pittsburgh Coal Company drill hole, located about 300 feet (90 m) east of Stony Run and about 11,000 feet (3350 m) west-southwest of the village of Brenizer.**Latitude:** 40°23'30"N**Longitude:** 79°18'31"W**Geologic unit:** Glenshaw Formation, Conemaugh Group**Description:** Medium-dark-gray to dark-gray underclay was penetrated between depths of 583 and 590.3 feet (178 and 179.9 m) in the drill hole. Calcite nodules up to 3/4 inch (1.9 cm) are rare but present in the interval. Stratigraphically, this interval probably occurs just below the Mahoning coal.**Attitude of bedding:** Essentially horizontal**Weathering intensity:** None

Sampled interval: Entire core between depths of 583 and 590.3 feet (178 and 179.9 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	50.20	Quartz	22	Water of plasticity (%): 20.0	
TiO ₂	0.92	Mica	54	Drying shrinkage (%): 5.0	
Al ₂ O ₃	17.60	Kaolinite	18	Workability: Short	
Fe ₂ O ₃	11.20	Chlorite-		Dry strength: Poor	
MnO	0.22	vermiculite	0	Drying defects: None	
MgO	0.98	Feldspar	1	pH: 9.8	
CaO	3.90	Montmo-			
Na ₂ O	0.27	rillonite	0		
K ₂ O	2.03	Calcite	2		
		Siderite	5		

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Beige	3	7.5	24.1	41.0	1.70
982						
1900	Beige	3	7.5	23.1	40.3	1.74
1038						
2000	Beige	3	10.0	21.9	38.6	1.76
1093						
2100	Dark gray	3	10.0	21.3	37.7	1.77
1149						
2200	Dark green	8	15.0	2.2	5.2	2.39
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Abrupt vitrification (2100-2200°F).

Potential uses: Not suitable for use in vitreous clay products.

WESTMORELAND COUNTY Derry Twp. Blairsville quad.

Sample number **47-B-3S**

Location: Rochester and Pittsburgh Coal Company drill hole, located about 300 feet (90 m) east of Stony Run and about 11,000 feet (3350 m) west-southwest of the village of Brenizer.

Latitude: 40°23'30"N

Longitude: 79°18'31"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Greenish-gray to dark-greenish-gray, thinly laminated shales and silty shales which grade down into claystone in the lower 2.5 feet (0.76 m) of the sampled interval. The entire sequence was penetrated between depths of 590.3 and 597.7 feet (179.9 and 182.2 m) in the drill hole. Stratigraphically, this interval is probably directly beneath the underclay of the Mahoning coal.

Attitude of bedding: Essentially horizontal

Weathering intensity: None

Sampled interval: Entire core between depths of 590.3 and 597.7 feet (179.9 and 182.2 m)

Chemical analysis:		Mineralogy (X-ray):		Raw properties:	
	%		%		
SiO ₂	54.20	Quartz	20	Water of plasticity (%)	15.0
TiO ₂	1.07	Mica	61	Drying shrinkage (%)	2.5
Al ₂ O ₃	19.20	Kaolinite	12	Workability	Short
Fe ₂ O ₃	9.78	Chlorite-		Dry strength	Poor
MnO	0.09	vermiculite	4	Drying defects	None
MgO	1.74	Feldspar	2	pH	9.8
CaO	2.11	Montmo-			
Na ₂ O	0.28	rillonite	0		
K ₂ O	3.04	Calcite	1		

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	5.0	14.0	27.6	1.97
982						
1900	Orange tan	3	5.0	13.4	26.7	2.00
1038						
2000	Light brown	5	7.5	10.7	22.5	2.10
1093						
2100	Red brown	5	7.5	9.1	19.5	2.16
1149						
2200	Dark brown	7	7.5	5.7	13.2	2.28
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Potential uses: Grade SW building brick; Type FBX facing brick; sewer pipe; liner plates.

WESTMORELAND COUNTY Derry Twp. Blairsville quad.Sample number **47-B-3W**

Location: Rochester and Pittsburgh Coal Company drill hole, located about 300 feet (90 m) east of Stony Run and about 11,000 feet (3350 m) west-southwest of the village of Brenizer.

Latitude: 40°23'30"N**Longitude:** 79°18'31"W**Geologic unit:** Freeport Formation, Allegheny Group

Description: Medium- to dark-gray, soft underclay to the Upper Freeport coal was penetrated between depths of 583.7 and 593.3 feet (177.9 and 180.8 m) in the drill hole. The underclay becomes slightly silty with depth. As the silt content increases the hardness of the underclay increases. The upper foot (0.3 m) of the underclay is darker in color than the rest of the sampled interval.

Attitude of bedding: Essentially horizontal**Weathering intensity:** None

Sampled interval: Entire core between depths of 583.7 and 593.3 feet (177.9 and 180.8 m)

Chemical analysis:**Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	57.2	Quartz	34	Water of plasticity (%): 20.4
TiO ₂	1.19	Mica	43	Drying shrinkage (%): 5.0
Al ₂ O ₃	19.50	Kaolinite	21	Workability: Short
Fe ₂ O ₃	6.60	Chlorite-		Dry strength: Poor
MnO	0.04	vermiculite	0	Drying defects: None
MgO	0.84	Feldspar	2	pH: 9.7
CaO	0.41	Montmo-		
Na ₂ O	0.32	rillonite	0	
K ₂ O	3.00	Calcite	1	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Beige	3	5.0	15.4	28.7	1.86
982						
1900	Beige	3	7.5	14.1	27.2	1.93
1038						
2000	Tan	4	7.5	12.5	25.0	2.00
1093						
2100	Tan	6	7.5	9.1	19.2	2.11
1149						
2200	Buff	7	7.5	7.5	16.2	2.16
1204						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2300 1260	Gray	7	10.0	4.4	9.6	2.18

Pyrometric cone equivalent: ND Bloating test: Negative

Remarks: Good color at 1900°F.

Potential uses: Grade SW building brick; Type FBS facing brick; facing tile.

WESTMORELAND COUNTY Derry Twp. Blairsville quad.

Sample number 47-B-3X

Location: Rochester and Pittsburgh Coal Company drill hole, located about 300 feet (90 m) east of Stony Run and about 11,000 feet (3350 m) west-southwest of the village of Brenizer.

Latitude: 40°23'30"N

Longitude: 79°18'31"W

Geologic unit: Kittanning Formation, Allegheny Group

Description: Medium-dark-gray soft underclay to the Upper Kittanning coal was penetrated between depths of 783.7 and 786.7 feet (238.9 and 239.8 m) in the drill hole. Carbonized plant debris is scattered throughout the interval.

Attitude of bedding: Essentially horizontal

Weathering intensity: None

Sampled interval: Entire core between depths of 783.7 and 786.7 feet (238.9 and 239.8 m)

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	58.6	Quartz	20	Water of plasticity (%): 17.0
TiO ₂	1.02	Mica	64	Drying shrinkage (%): 5.0
Al ₂ O ₃	22.90	Kaolinite	10	Workability: Short
Fe ₂ O ₃	4.70	Chlorite-		Dry strength: Fair
MnO	0.03	vermiculite	5	Drying defects: None
MgO	1.32	Feldspar	2	pH: 9.4
CaO	0.20	Montmo-		
Na ₂ O	0.35	rillonite	0	
K ₂ O	4.14	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Beige	3	5.0	13.6	25.9	1.91
982						
1900	Tan	3	5.0	12.7	24.4	1.93
1038						
2000	Orange tan	6	5.0	9.0	18.5	2.05
1093						
2100	Light brown	6	7.5	6.1	13.2	2.17
1149						
2200	Dark brown	7.5	10.0	3.8	8.6	2.27
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Poor colors.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe.

WESTMORELAND COUNTY Unity Twp. Latrobe quad.Sample number **47-C-2**

Location: Strip pit operated by Adam Eidemiller, located about 5000 feet (1520 m) east-southeast of the village of Donohoe and south of the railroad.

Latitude: 40°18'36"N

Longitude: 79°27'33"W

Geologic unit: Freeport Formation, Allegheny Group

Description: Dark-gray to grayish-black underclay to the Upper Freeport coal is partially exposed in the bottom of the pit. The underclay is relatively hard, and breaks down into hackly to rubbly fragments up to 3 inches (7.6 cm) long that are subangular to rounded. Total thickness of the underclay is unknown; the exposure of underclay in the pit is limited to the upper foot (0.3 m).

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Channel sample through the upper foot (0.3 m) of underclay

Chemical analysis:

	%
SiO ₂	55.0
TiO ₂	1.0
Al ₂ O ₃	21.1
Fe ₂ O ₃	6.3
FeO	1.0
MnO	0.03
MgO	1.0
CaO	0.34
Na ₂ O	0.16
K ₂ O	3.6
P ₂ O ₅	0.15
S (total)	4.1
C (org.)	1.3
CO ₂	0.02
H ₂ O ⁻	1.4
H ₂ O ⁺	7.1

Mineralogy (X-ray):

	%
Quartz	22
Mica	56
Kaolinite	15
Chlorite-	
vermiculite	2
Feldspar	1
Montmorillonite	0
Calcite	0
Pyrite	2
Pyrophyllite	2
Goethite present	

Raw properties:

Water of plasticity (%):	15.6
Drying shrinkage (%):	5.0
Workability:	Short
Dry strength:	Fair
Drying defects:	None
pH:	4.5

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	2	5.0	18.2	31.9	1.75
982						
1900	Tan	3	5.0	12.3	24.2	1.96
1038						
2000	Tan	3	5.0	10.3	21.2	2.06
1093						
2100	Brown	4	7.5	4.0	9.2	2.30
1149						
2200	--	--	Expanded	--	--	--
1204						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Fair color at 1900°F.

Potential uses: Grade MW building brick; Type FBA facing brick.

WESTMORELAND COUNTY Cook Twp. Mammoth quad.

Sample number 48-A-2

Location: Strip pit operated by C. W. Brown Company located about 1 mile (1.6 km) south-southeast of the lookout tower near the St. Boniface Chapel.

Latitude: 40°11'31"N

Longitude: 79°22'42"W

Geologic unit: Freeport Formation, Alleghenv Group

Description: Olive-gray carbonaceous underclay to the Upper Freeport coal is partially exposed in this pit. Thickness is undetermined because only the upper foot (0.3 m) of the underclay is exposed.

Attitude of bedding: N10E, 8E

Weathering intensity: Unweathered

Sampled interval: Channel sample through the upper foot (0.3 m) of underclay

Chemical analysis:

	%
SiO ₂	54.2
TiO ₂	1.6
Al ₂ O ₃	24.6
Fe ₂ O ₃	3.7
FeO	0.65
MnO	0.01
MgO	0.42
CaO	0.09
Na ₂ O	0.14
K ₂ O	2.5
P ₂ O ₅	0.19
S (total)	2.0
C (org.)	1.5
CO ₂	0.01
H ₂ O ⁻	1.5
H ₂ O ⁺	8.4

Mineralogy (X-ray):

	%
Quartz	15
Mica	63
Kaolinite	16
Chlorite- vermiculite	5
Feldspar	1
Montmorillonite	0
Calcite	0

Raw properties:

Water of plasticity (%): 17.3
Drying shrinkage (%): 5.0
Workability: Plastic
Dry strength: Good
Drying defects: None
pH: 3.9

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Cream	3	5.0	17.3	32.0	1.85
982						
1900	Ivory	3	5.0	15.2	29.0	1.91
1038						
2000	Buff	6	7.5	12.8	25.5	2.00
1093						
2100	Gray	6	10.0	3.6	8.2	2.30
1149						
2200	Gray green	7	12.5	0.5	1.1	2.34
1204						
2300	Gray green	7	15.0	0.6	1.3	2.30
1260						

Pyrometric cone equivalent: ND

Bloating test: Negative

Remarks: Good color (2000°F). No effervescence with HCl.

Potential uses: Grade SW building brick; Type FBX facing brick.

WESTMORELAND COUNTY Derry Twp. Bolivar quad.

Sample number **57-A-3**

Location: Acko Coal Corp. strip mine, located about 2000 feet (610 m) south of Torrance.

Latitude: 40°24'41"N

Longitude: 79°13'25"W

Geologic unit: Pleistocene claystone

Description: Medium- to medium-dark-gray, soft, plastic claystone, approximately 1 foot (0.3 m) thick, occurs in the soil. The claystone and soil appear to be developed in a Pleistocene channel through the upper portion of the highwall. The exposure is not good enough to determine the geometry of the claystone.

Attitude of bedding: Coal dipping 12SW

Weathering intensity: Slight to moderate

Sampled interval: Channel through 1 foot (0.3 m) of claystone

Chemical analysis:

Mineralogy (X-ray):

Raw properties:

	%		%	
SiO ₂	62.60	Quartz	29	Water of plasticity (%): 22.2
TiO ₂	1.28	Mica	37	Drying shrinkage (%): 2.5
Al ₂ O ₃	21.85	Kaolinite	33	Workability: Plastic
Fe ₂ O ₃	2.55	Chlorite-		Dry strength: Good
MnO	0.01	vermiculite	0	Drying defects: None
MgO	0.88	Feldspar	1	pH: 3.4
CaO	0.21	Montmo-		
Na ₂ O	0.16	rillonite	0	
K ₂ O	3.52	Calcite	0	

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
1800	Tan	3	2.5	20.1	34.2	1.71
982						
1900	Tan	3	2.5	16.2	28.9	1.78
1038						
2000	Tan	4	5.0	10.7	21.1	1.97
1093						
2100	Light brown	5	7.5	3.5	7.7	2.22
1149						

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
2200	Gray	5	7.5	0.7	1.6	2.26
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND **Bloating test:** Negative

Remarks: Good color at 2000°F. No effervescence when treated with HCl.

Potential uses: Grade SW building brick; Type FBA facing brick.

WESTMORELAND COUNTY Fairfield Twp. Wilpen quad.

Sample number **57-C-4**

Location: Pennsylvania Department of Transportation drill core from hole #1 at LR 64061, located where Tubmill Creek crosses LR 64061, about 6500 feet (1980 m) northwest of West Fairfield.

Latitude: 40°21'54"N

Longitude: 79°08'20"W

Geologic unit: Glenshaw Formation, Conemaugh Group

Description: Greenish-gray to medium-dark-gray, interbedded silty shales and calcareous shales occur at depths of 20 to 29.5 feet (6 to 9 m). Stratigraphically this interval probably belongs in the middle third of the Glenshaw Formation.

Attitude of bedding: Essentially horizontal

Weathering intensity: Slight

Sampled interval: Entire core between depths of 20 and 29.5 feet (6 to 9 m)

Chemical analysis: **Mineralogy (X-ray):** **Raw properties:**

	<i>%</i>		<i>%</i>	
SiO ₂	54.30	Quartz	24	Water of plasticity (%): 17.0
TiO ₂	0.90	Mica	57	Drying shrinkage (%): 5.0
Al ₂ O ₃	16.60	Kaolinite	11	Workability: Short
Fe ₂ O ₃	6.00	Chlorite-		Dry strength: Poor
MnO	0.16	vermiculite	2	Drying defects: None
MgO	1.65	Feldspar	2	pH: 9.0
CaO	6.30	Montmo-		
Na ₂ O	0.17	rillonite	0	
K ₂ O	3.10	Calcite	3	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Beige	3	5.0	16.6	30.2	1.83
982						
1900	Light brown	3	5.0	15.4	28.6	1.86
1038						
2000	Light brown	3	5.0	15.3	28.6	1.87
1093						
2100	Chocolate brown	5	5.0	13.4	25.7	1.92
1149						
2200	Dark brown	8	7.5	1.9	4.1	2.09
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Bloating tests (quick-firing):

Crushing characteristics: Tabular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

<i>Temp.</i> (°F) (°C)	<i>Bulk density</i> (gm/cc) (lb/ft ³)		<i>% Absorb.</i>	<i>Remarks</i>
1800	2.05	127.9	3.7	No expansion.
982				
1900	1.97	122.9	6.6	No expansion.
1038				
2000	1.82	113.5	5.0	No expansion.
1093				
2100	1.25	78.0	8.0	Mixed bloating and non-bloating.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Not suitable for use in lightweight aggregate (mixture of bloating and nonbloating materials).

Potential uses: Grade MW building brick.

WESTMORELAND COUNTY Fairfield Twp. Wilpen quad.Sample number **57-C-5**

Location: Pennsylvania Department of Transportation core hole #1 at Site A of LR 302, Station 135 + 13, 35 feet (11 m) right, located about 5500 feet (1680 m) southwest of West Fairfield.

Latitude: 40°20'12"N**Longitude:** 79°08'10"W**Geologic unit:** Glenshaw Formation, Conemaugh Group

Description: Medium- to dark-gray, silty shale was cored between depths of 24.7 and 29 feet (7.5 and 9 m). Locally the shale is contaminated with coaly material. Siltstone occurs under the shale. The type of material that overlies the sampled interval is unknown because it was not cored from the surface to a depth of 24.7 feet (7.5 m). Stratigraphically, the sampled interval probably belongs near the position of the Harlem coal.

Attitude of bedding: Essentially horizontal**Weathering intensity:** Slight**Sampled interval:** Entire core from 24.7 to 29 feet (7.5 to 9 m) in depth**Chemical analysis:****Mineralogy (X-ray):****Raw properties:**

	%		%	
SiO ₂	57.50	Quartz	20	Water of plasticity (%): 18.0
TiO ₂	0.99	Mica	62	Drying shrinkage (%): 2.5
Al ₂ O ₃	17.70	Kaolinite	10	Workability: Short
Fe ₂ O ₃	7.97	Chlorite-		Dry strength: Poor
MnO	0.18	vermiculite	6	Drying defects: None
MgO	1.82	Feldspar	4	pH: 8.8
CaO	0.50	Montmo-		
Na ₂ O	0.70	rillonite	0	
K ₂ O	2.92	Calcite	0	

Slow-firing tests:

<i>Temp.</i> (°F) (°C)	<i>Color</i>	<i>Hard- ness</i> (Moh's scale)	<i>% Total shk.</i>	<i>% Absorb.</i>	<i>% App. Por.</i>	<i>Bulk density</i> (gm/cc)
1800	Beige	3	5.0	16.9	30.9	1.82
982						
1900	Orange tan	3	5.0	14.0	26.8	1.91
1038						
2000	Light brown	5	7.5	10.6	21.6	2.04
1093						

Slow-firing tests:

Temp. (°F) (°C)	Color	Hard- ness (Moh's scale)	% Total shk.	% Absorb.	% App. Por.	Bulk density (gm/cc)
2100	Red brown	6	10.0	4.5	10.1	2.26
1149						
2200	Dark brown	8	10.0	0.7	1.5	2.27
1204						
2300	--	--	Expanded	--	--	--
1260						

Pyrometric cone equivalent: ND

Bloating test: Positive

Remarks: Fair color at 2100°F.

Bloating tests (quick-firing):

Crushing characteristics: Angular

Particle size: -3/4" (1.9 cm) lumps

Retention time: 15 min.

Temp. (°F) (°C)	Bulk density (gm/cc) (lb/ft ³)		% Absorb.	Remarks
1800	1.98	123.5	8.5	No expansion.
982				
1900	1.61	100.4	13.4	Slight expansion.
1038				
2000	1.06	66.1	18.2	Good pore structure.
1093				
2100	0.83	51.8	20.2	Overbloated; large pores.
1149				
2200	--	--	--	--
1204				
2300	--	--	--	--
1260				

Remarks: Promising raw material for lightweight aggregate.

Potential uses: Grade SW building brick; Type FBA facing brick; sewer pipe; promising raw material for lightweight aggregate.

POTENTIAL USES OF CLAYS AND SHALES COMPILED BY COUNTY, GEOLOGIC UNIT, AND SAMPLE NUMBER

Table 17 is a compilation showing the potential uses for the 413 samples involved in the study. The table is organized by county, stratigraphic position, and, finally, by sample number. The stratigraphic units are shown in order of increasing geologic age, and conform to the stratigraphic column shown on Plate 1.

This compilation is a guide to sites where raw materials that have potential for certain uses occur. It keys each sample, wherever possible, to its stratigraphic interval. Each entry is cross referenced by county and sample number to a data sheet presented in the "Sample Data and Test Results" section.

CORRELATION OF GEOLOGIC UNITS AND USES

GENERAL STATEMENT

Enough samples (413) were studied to justify attempts at correlations between geologic units and potential uses. From a practical standpoint, a geologic unit that has a high percent of samples suitable as raw material for a particular use should be regarded as a good exploration target. The geologic units referred to in this report are stratigraphic intervals that are identified in the generalized stratigraphic column presented on Plate 1. Each interval consists of either a geologic group, a formation, or a part of a formation. The use of the stratigraphic column when reading this section is encouraged. By combining the information in the stratigraphic column with that on the geologic map in Plate 1, it is possible to define the approximate locations in southwestern Pennsylvania where a geologic interval of interest is present at the surface. In most cases, the accurate location of any subdivision within a formation will require field examination.

The percent of the total number of samples suitable for each use is shown graphically in Figure 5. To illustrate, 84 percent of the 413 samples met the test criteria for use as raw material for building brick, whereas only 14 percent of the samples tested satisfactorily for use in the production of sewer pipe.

EXPLORATION TARGETS

General

The percent of samples suitable for each use from 42 different stratigraphic units appears in Table 18. Percents shown in bold type identify the

Table 17. Potential Uses of Clays and Shales, Compiled by County, Geologic Unit, and Sample Number

Group	Formation	Sample number	Building brick grade				Facing brick type				Floor brick type				Liner plates (vitrified)		Sewer pipe	Drain tile	Structural tile		Stoneware	Lt. wt. aggregate Rotary kiln			Refractories		No uses	Type of material and stratigraphic position (refer to Plate 1)
			SW	MW	NW	FBX	FBS	FBA	T	H	M	L	Facing	Load bearing	Marginal	Promising			Low duty	Medium duty								
ALLEGHENY COUNTY																												
Monongahela	Pittsburgh	27-C-11D	X																									Silty shales above the Redstone coal.
	do.	27-C-9	X																									Shales above the Redstone coal.
	do.	27-C-11A	X																									Fissile shales above the Redstone coal.
	do.	27-C-11B	X																									Claystones above the Redstone coal.
	do.	27-C-11C	X																									Do.
Conemaugh	Casselman	6-D-16	X																									Underclay to the Pittsburgh coal.
Do.	do.	6-D-17																										Claystones, shales, and some thin limestone beds below the Pittsburgh coal.
Do.	do.	28-A-4J	X																									Shales and silty shales above the Morgantown sandstone.
Do.	do.	28-A-4K																										Silty shale about 47 feet (14 m) above the Morgantown sandstone.
Do.	do.	28-A-4H	X																									Silty shales and a few siltstones above the Morgantown sandstone.
Do.	do.	28-A-4I																										Morgantown sandstone.
Do.	do.	17-B-3B	X																									Twelve feet (4 m) of shale in an interval whose base is 25 feet (8 m) above the Morgantown sandstone.
Do.	do.	27-C-10B	X																									Shales and silty shales of the Birmingham shale unit.
Do.	do.	17-B-3A	X																									Shaly siltstones 15 to 30 feet (5 to 9 m) above the Ames limestone (Birmingham shale unit?).
Do.	do.	27-C-10A	X																									Shales of the Birmingham shale unit.
																												Fissile shales within the Birmingham shale unit.

Table 17. (Continued)

Group	Formation	Sample number	Building brick grade			Facing brick type			Floor brick type				Liner plates (vitrified)	Sewer pipe	Drain tile	Structural tile		Lt. wt. aggregate Rotary kiln			Refractories		Type of material and stratigraphic position (refer to Plate 1)
			SW	MW	NW	FBX	FBS	FBA	T	H	M	L				Facing	Load bearing	Stoneware	Marginal	Promising	Low duty	Medium duty	
Conemaugh	Casselman	28-A-4A		X										X									Shales and a few silty shale beds within the Birmingham shale unit.
Do.	do.	28-A-4B	X											X									Shales and occasional siltstone in the Birmingham shale unit.
Do.	do.	28-A-4C	X											X									Shales and clayey shales in the Birmingham shale unit.
Do.	do.	28-A-4E		X							X									X			Shales in the Birmingham shale unit.
Do.	do.	28-A-4D		X										X									Shales and clayey shales in the Birmingham shale unit.
Do.	do.	28-A-4G	X											X									Do.
Do.	do.	27-C-10C	X											X									Claystones from 42 to 55 feet (13 to 17 m) above the Ames limestone (Birmingham shale unit?).
Do.	Glenshaw	16-C-7	X								X												Claystones; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	16-C-8	X						X					X									Sampled interval includes underclay, claystone, and shales; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	16-C-10		X				X												X			Fissile shales, silty shales, and shaly siltstones; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	17-B-2A	X					X															Silty shales from 0 to 10 feet (0 to 3 m) below a sandstone unit.
Do.	do.	17-B-2B																					Silty shales below sample 17-B-2A.
Do.	do.	16-C-9	X					X						X						X			Shales within the Brush Creek unit.
Do.	do.	28-A-4L	X																	X			Shales stratigraphically above the Brush Creek coal
ARMSTRONG COUNTY																							Claystones from 10 to 19 feet (3 to 6 m)
Monongahela	Pittsburgh	46-C-2B	X				X							X									

Table 17. (Continued)

Group	Formation	Sample number	Building brick grade			Facing brick type				Floor brick type				Liner plates (vitrified)	Sewer pipe	Drain tile		Structural tile		Stoneware	Lt. wt. aggregate Rotary kiln		Refractories		No uses	Type of material and stratigraphic position (refer to Plate I)
			SW	MW	NW	FBX	FBS	FBA	T	H	M	L	Facing			Load bearing	Marginal	Promising	Low duty		Medium duty					
Conemaugh	Glenshaw	5-D-11	X					X																		Silty shales; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	5-D-12	X				X														X					Semifissile shales; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	5-D-13	X				X		X						X							X				Composite of samples 5-D-10, 5-D-11, and 5-D-12.
Do.	do.	6-A-7	X				X								X											Silty shales; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	6-D-11	X							X					X											Claystones; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	6-D-21	X					X													X					Glenshaw Formation is uncertain. Fissile to thin-bedded shales; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	6-D-22	X																							Silty shales; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	6-D-23	X																							Silty claystones; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	6-D-24	X					X		X					X											Silty claystones; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	6-D-25	X							X					X											Silty shales within the Pittsburgh red beds.
Do.	do.	6-B-10	X																			X				Semifissile to medium-bedded, clayey to slightly silty shales above the Brush Creek coal.
Do.	do.	6-B-9	X																							Underclay to the Brush Creek coal.
Do.	do.	6-C-14	X				X				X				X											Silty claystones and clayey siltstones from 5 to 11 feet (1.5 to 3 m) above the Upper Freeport coal.

CORRELATION OF GEOLOGIC UNITS AND USES

[illegible]

Table 17. (Continued)

Group	Formation	Sample number	Building brick grade			Facing brick type				Floor brick type				Liner plates (vitrified)	Sewer pipe	Drain tile	Structural tile		Lt. wt. aggregate Rotary kiln	Refractories		No uses	Type of material and stratigraphic position (refer to Plate I)	
			SW	MW	NW	FBX	FBS	FBA	T	H	M	L	Facing				Load bearing	Stoneware		Marginal	Promising			Low duty
Allegheny	Kittanning	5-C-16	X				X																Claystones and shaly claystones stratigraphically below the Middle Kittanning coal.	
Do.	do.	5-C-15	X					X											X				Shales above the Lower Kittanning coal.	
Do.	do.	5-C-27	X																				Claystones above the Lower Kittanning coal.	
Do.	do.	5-D-14																					Shales stratigraphically within the lower part of the Kittanning Formation. Only potential use is as a nonplastic component for structural clay products.	
Do.	Clarion	5-D-6	X					X											X				Silty shales; stratigraphic position in the Clarion Formation is uncertain.	
Do.	do.	5-C-29	X					X												X			Underclay to the Lower Kittanning coal.	
Do.	do.	6-A-8		X																X			Do.	
Do.	do.	5-C-26	X				X														X		Do.	
BUTLER COUNTY																								
Conemaugh	Glenshaw	16-A-6	X																	X			Silty shales; probably stratigraphically below the Ames limestone.	
Allegheny	Freeport	15-D-10	X					X															Shaly siltstones directly above the Lower Freeport coal.	
Do.	Kittanning	24-C-3		X				X															Silty shales from 10 to 20 feet (3 to 6 m) above the Middle Kittanning coal.	
Do.	do.	15-A-8B	X					X												X			Silty claystones from 10 to 20 feet (3 to 6 m) above the Middle Kittanning coal.	
Do.	do.	24-C-2B	X					X															Slightly silty shales from 0 to 10 feet (0 to 3 m) above the Middle Kittanning coal.	

Locality	Section	15-A 8A	15-D-9	24-C 2A	34-A 12	24-B-1B	34-A-11B	34 A 10B	34 A 11A	34 A 11C	34 A 10A	24 B 4B	24 B 1A	24-B 4A	Notes
Do.	do.	X													Silty shales from 0 to 10 feet (0 to 3 m) above the Middle Kittanning coal. Underclay to the Middle Kittanning coal.
Do.	do.		X												Do.
Do.	do.			X											Silty shales above the Lower Kittanning coal.
Do.	do.				X										Do.
Do.	Clarion														Claystones above the Vanport limestone.
Do.	do.	X													Shaly claystones above the Vanport limestone.
Do.	do.	X													Stone.
Do.	do.														Slightly silty shales above the Upper Clarion coal.
Do.	do.	X													Do.
Do.	do.														Underclay to the Upper Clarion coal.
Do.	do.														Do.
Do.	do.														Do.
Do.	do.														Underclay to the Clarion coal.
Pottsville	do.														Underclay to the Brookville coal.
CAMBRIA COUNTY															
Conemaugh	Casselman	76 C 5	X												Shales and silty shales; stratigraphic position in the Casselman Formation is uncertain.
Do.	do.	76 D 6													Claystones, shales, and silty shales; stratigraphic position in the Casselman Formation is uncertain.
Do.	do.	77-A 1													Fissile shales; stratigraphic position in the Casselman Formation is uncertain.
Do.	do.	77 A 2	X												Shales and silty shales; stratigraphic position in the Casselman Formation is uncertain.
Do.	do.	77-A 8	X												Claystones and clayey siltstones; stratigraphic position in the Casselman Formation is uncertain.
Do.	do.	77 C 3	X												Silty shales; stratigraphic position in the Casselman Formation is uncertain.
Do.	do.	67 D 3A													Fissile shales near the Wellersburg(?) coal.
Do.	do.	67 D 3B													Claystones beneath the Wellersburg(?) coal.
Do.	Glenshaw	66-D 4	X												Shales and silty shale; stratigraphic position in the Glenshaw Formation is uncertain.

Table 17. (Continued)

Group	Formation	Sample number	Building brick grade			Facing brick type				Floor brick type			Liner plates (vitrified)	Sewer pipe	Drain tile	Structural tile		Lt. wt. aggregate Rotary kiln		Refractories		Type of material and stratigraphic position (refer to Plate 1)
			SW	MW	NW	FBX	FBS	FBA	T	H	M	L				Facing	Load bearing	Marginal	Promising	Low duty	Medium duty	
Monongahela	Uniontown	28-C-7	X										X	X								Shaly siltstones above the Uniontown(?) coal.
Do	Pittsburgh	29-B-3	X				X												X			Fissile shales; stratigraphic position in the Pittsburgh Formation is uncertain.
Do	do.	29-C-4A	X							X												Fissile shales above the Sewickley coal.
Do	do.	29-B-6	X												X							Shales above the Redstone coal.
Do	do.	29-C-4B	X					X						X	X							Claystones above the Redstone coal.
Do	do	39-B-6	X					X						X	X							Silty shales and shales above the Redstone coal.
Do	do	39-C-2A	X					X							X							Shales and silty shales; stratigraphic position is probably about 2.5 to 9.0 feet (0.8 to 2.7 m) above the Pittsburgh rider.
Do	do.	39-C-2B													X							Shales above the Pittsburgh rider coal.
Conemaugh	Casselman	39-C-2C	X			X										X						Underclay to the Pittsburgh coal.
Do.	do	39-C-2D																			X	Shales and silty shales above the Upper Pittsburgh limestones.
Do.	do.	39-C-2E	X																			Do.
Do.	do	39-C-2F	X					X								X						Claystones and shales occur about 36 feet (11 m) below the base of the Pittsburgh coal.
Do.	do.	39-C-2G	X																			Shale interval occurs 46 to 51 feet (14 to 16 m) below the Pittsburgh coal.
Do.	do.	29-C-5		X																		Silty shales, probably within the Birmingham shale unit.
Do.	Glenshaw	39-D-8	X							X				X								Shaly siltstones; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	140-A-1A	X																			Shales; stratigraphic position in the Glenshaw Formation is probably above a coal in the Bakerstown unit.

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GREENE COUNTY

[illegible]

Table 17. (Continued)

Group	Formation	Sample number	Building brick grade			Facing brick type			Floor brick type				Liner plates (vitrified)		Sewer pipe	Drain tile	Structural tile		Stoneware	Lt. wt. aggregate Rotary kiln		Refrac-tories		Type of material and stratigraphic position (refer to Plate 1)
			SW	MW	NW	FBX	FBS	FBA	T	H	M	L	Liner plates (vitrified)				Facing	Load bearing		Marginal	Promising	Low duty	Medium duty	
Dunkard	Greene	19-A-8	X																					Silty shales; stratigraphic position in the Greene Formation is uncertain.
Do.	Washington	9-A-7	X				X							X										Silty claystones; stratigraphic position in the Washington Formation is uncertain.
Do.	do.	9-D-3	X							X														Shales; stratigraphic position in the Washington Formation is uncertain.
Do.	do.	19-A-3	X								X									X				Shales and silty shales; stratigraphic position in the Washington Formation is uncertain.
Do	do.	19-D-4A	X								X													Claystones; stratigraphic position in the Washington Formation is uncertain.
Do.	do.	19-D-4B	X				X			X														Shaly siltstones and silty shales; stratigraphic position in the Washington Formation is uncertain.
Do.	do.	19-D-4C	X								X													Shales; stratigraphic position in the Washington Formation is uncertain.
Do.	do.	19-D-4D		X			X			X							X							Shales and mudstones; stratigraphic position in the Washington Formation is uncertain.
Do.	do.	19-D-4E																				X		Shales; stratigraphic position in the Washington Formation is uncertain.
Do.	do.	19-D-4F	X				X			X														Shales and shaly siltstones; stratigraphic position in the Washington Formation is uncertain.
Do.	do.	19-D-5A	X										X							X				Shaly siltstones and shales; stratigraphic position in the Washington Formation is uncertain.

Table 17. (Continued)

Group	Formation	Sample number	Building brick grade			Facing brick type			Floor brick type				Liner plates (vitrified)	Sewer pipe	Drain tile	Structural tile		Stoneware	Lt. wt. aggregate Rotary kiln		Refractories		No uses	Type of material and stratigraphic position (refer to Plate 1)
			SW	MW	NW	FBX	FBS	FBA	T	H	M	L				Facing	Load bearing		Marginal	Promising	Low duty	Medium duty		
Conemaugh	Casselman	46-D-7	X									X												Silty shales; stratigraphic position in the Casselman Formation is uncertain.
Do.	do.	47-B-4	X									X							X					Shales; stratigraphic position in the Casselman Formation is uncertain.
Do.	do.	57-A-6	X								X													Shales; stratigraphic position in the Casselman Formation is uncertain.
Do.	Glenshaw	46-C-6	X						X					X										Silty shales and shaly siltstones; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	46-D-3	X						X					X					X					Shales; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	46-D-4	X						X					X					X					Shaly siltstones; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	47-B-5	X																					Silty shales; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	55-C-2	X																X					Shales; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	55-D-1A	X														X							Silty shales; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	55-D-1B	X														X							Fissile shale; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	56-A-8	X																X					Shales and fissile shales; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	56-A-9	X																					Silty shales; stratigraphic position in the Glenshaw Formation is uncertain.
Do.	do.	56-A-11	X																					Do.
Do.	do.	56-B-6A	X																					Silty shales and shales; stratigraphic position in the Glenshaw Formation is uncertain.

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Table 17. (Continued)

Group	Formation	Sample number	Building brick grade			Facing brick type				Floor brick type				Liner plates (vitrified)	Sewer pipe	Drain tile	Structural Tile		Lt. wt. aggregate Rotary kiln			Refractories		No uses	Type of material and stratigraphic position (refer to Plate I)
			SW	MW	NW	FBX	FBS	FBA	T	H	M	L	Facing				Load bearing	Marginal	Promising	Low duty	Medium duty				
Allegheny	Kittanning	5-B-33																						X	Shales and silty shales; stratigraphic position in the Kittanning Formation is uncertain.
Do.	do.	5-B-31A																		X					Fissile shales and interbedded silty shales occur above the Middle Kittanning(?) coal.
Do.	do.	5-B-31B																							Underclay to the Middle Kittanning coal.
Do.	do.	4-C-3A					X																		Do.
Do.	do.	4-C-3B					X																		Claystones; stratigraphically below the underclay to the Middle Kittanning coal.
Do.	do.	4-D-4A					X																		Silty claystones; stratigraphically between the Middle and Lower Kittanning coals.
Do.	do.	4-D-4B					X																		Do.
Do.	do.	5-A-24	X				X													X					Fissile to thin-bedded shales above the Lower Kittanning coal.
Do.	?	14-C-1																						X	Shales; probably within the lower part of the Allegheny Group.
Do.	Clarion	15-A-13	X																						Claystone and silty claystones; stratigraphic position in the Clarion Formation is uncertain.
Do.	do.	4-C-3C						X																	Underclay to the Lower Kittanning(?) coal.
Do.	do.	5-A-20	X			X														X					Underclay to the Lower Kittanning coal.
Do.	do.	5-A-21	X			X														X					Do.
Do.	do.	5-A-22	X			X														X					Do.
Do.	do.	5-A-23	X			X														X					Do.
Do.	do.	5-C-25	X			X														X					Do.
Do.	do.	5-B-31C					X																	X	Underclay to the Lower Kittanning coal.

CORRELATION OF GEOLOGIC UNITS AND USES

Locality	Sample	5-B-31D	4-C-3D	4-C-3E	5-B-31E	4-C-2A	4-C-3F	4-C-2B	4-C-1B	4-C-1A	4-C-2C	15-A-11	5-B-32A	5-B-32B	5-B-32C	5-B-32D	5-B-32E	Notes
Do.	do.	X																Shales and silty shales occur about 20 feet (6 m) above the Vanport limestone.
Do.	do.	X																Fissile shales and silty shales occur from 0 to 8 feet (0 to 2.4 m) above the Vanport limestone.
Do.	do.			X														Underclay to the Scrubgrass(?) coal.
Do.	do.			X														Underclay to the Scrubgrass(?) coal.
Do.	do.			X														Claystones and a few siltstone beds occur above the Clarion(?) coal.
Do.	do.	X																Underclay to the Clarion coal.
Do.	do.																	Claystones below the Clarion coal.
Do.	do.																	Claystones occur from 18 to 22 feet (5 to 7 m) above the Brookville coal.
Do.	do.																	Shales above the Brookville coal.
Do.	do.																	Claystones above the Brookville coal.
Pottsville	do.																	Shales; stratigraphic position in the Pottsville Group is uncertain.
Do.	do.																	Hard underclay(?) below an unidentified coal.
Do.	do.																	Plastic underclay below sample 5-B-32A.
Do.	do.																	Silty clay beneath sample 5-B-32B.
Do.	do.																	Shales and silty shales beneath sample 5-B-32C.
Do.	do.																	Underclay to the Middle Mercer(?) coal.
Monongahela	Pittsburgh																	Silty shales above rider no. 2 to the Sewickley coal.
Do.	do.																	Silty shales below rider no. 2 to the Sewickley coal.
Do.	do.																	Shales below rider no. 1 to the Sewickley coal.
Do.	do.																	Silty claystone above rider no. 2 to the Redstone coal.
Do.	do.																	Silty shales and claystones between rider coals to the Redstone coal.
Do.	do.																	Silty claystone above the Redstone coal.
Do.	do.																	Shales and silty shales above the Pittsburgh coal.
Do.	do.																	Predominantly shales and silty shales above the Pittsburgh coal.

Table 17. (Continued)

Group	Formation	Sample number	Building brick grade			Facing brick type			Floor brick type				Liner plates (vitrified)	Sewer pipe	Drain tile	Structural tile		Lt. wt. aggregate Rotary kiln		Refractories		No uses	Type of material and stratigraphic position (refer to Plate 1)	
			SW	MW	NW	FBX	FBS	FBA	T	H	M	L				Facing	Load bearing	Marginal	Promising	Low duty	Medium duty			
Conemaugh	Casselman	59-D-24	X						X															Fissile shales, probably 20 to 40 feet (6 to 12 m) below the Pittsburgh coal.
Do.	do.	59-D-25																				X		Underlay to an unidentified coal. Sample interval occurs from 40 to 50 feet (12 to 15 m) below the Pittsburgh coal.
Do.	Glenshaw	59-A-13	X					X							X				X					Silty shales above sample 59-D-12. Exact stratigraphic position in the formation is uncertain.
Do.	do.	59-A-12		X														X						Semifissile to thin-bedded shales; exact stratigraphic position in the formation is uncertain.
Do.	do.	68-A-11	X					X						X										Silty shales (fissile to thick-bedded); exact stratigraphic position in the formation is uncertain.
Do.	do.	69-A-10	X																					Silty shales above the Bakerstown(?) coal.
Do.	do.	69-A-9	X						X															Silty shales above a coal in the Bakerstown unit.
Do.	do.	69-A-8		X																				Underlay to a coal within the Bakerstown(?) unit.
Do.	do.	140-B-1		X																				Shales and silty shales in the lower part of the Glenshaw Formation.
Do.	do.	69-A-2	X						X															Semifissile shales and claystones above the Upper Freeport coal.
Do.	do.	59-B-10	X						X															Fissile shales and sandy shales above the Upper Freeport coal.
Do.	do.	59-B-9	X																X					Fissile silty shale above the Upper Freeport rider coal.

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WASHINGTON COUNTY

[illegible]

WESTMORELAND COUNTY

[illegible]

Table 17. (Continued)

Group	Formation	Sample number	Building brick grade			Facing brick type				Floor brick type				Liner plates (vitrified)		Sewer pipe	Drain tile	Structural tile		Lt. wt. aggregate Rotary kiln		Refractories		No uses	Type of material and stratigraphic position (refer to Plate 1)	
			SW	MW	NW	FBX	FBS	FBA	T	H	M	L	Facing					Load bearing	Marginal	Promising	Low duty	Medium duty				
Conemaugh	Casselman	28-B-3B		X																					Shales and some silty shales; stratigraphic position within the Casselman Formation is uncertain.	
Do.	do.	28-B-3A																		X					X	Claystones; stratigraphic position within the Casselman Formation is uncertain.
Do.	do.	28-B-6A	X			X												X								Underclay to the Pittsburgh coal.
Do.	do.	38-B-4	X			X												X								Do.
Do.	do.	28-B-6R																							X	Claystones within the Birmingham shale unit.
Do.	do.	28-B-6S																							X	Calcareous claystones; probably within the Birmingham shale unit.
Do.	do.	28-B-6T	X														X								X	Claystones and shales within the Birmingham shale unit.
Do.	do.	28-B-6Q																							X	Calcareous claystones within the Birmingham shale unit.
Do.	do.	28-B-6P	X																	X						Claystones within the Birmingham shale unit.
Do.	do.	28-B-6O	X																	X	X					Shales within the Birmingham shale unit.
Do.	do.	28-B-6V	X					X							X					X	X					Silty shales within the Birmingham shale unit.
Do.	do.	28-B-6N	X													X										Claystones and calcareous claystones within the Birmingham shale unit.
Do.	do.	28-B-6M	X																		X					Claystones above the Ames limestone in the Birmingham shale unit.
Do.	do.	47-A-3	X																		X					Silty shales probably within the Birmingham shale unit.
Do.	Glenshaw	57-C-5	X													X										Silty shales near the stratigraphic position of the Harlem coal.

CORRELATION OF GEOLOGIC UNITS AND USES

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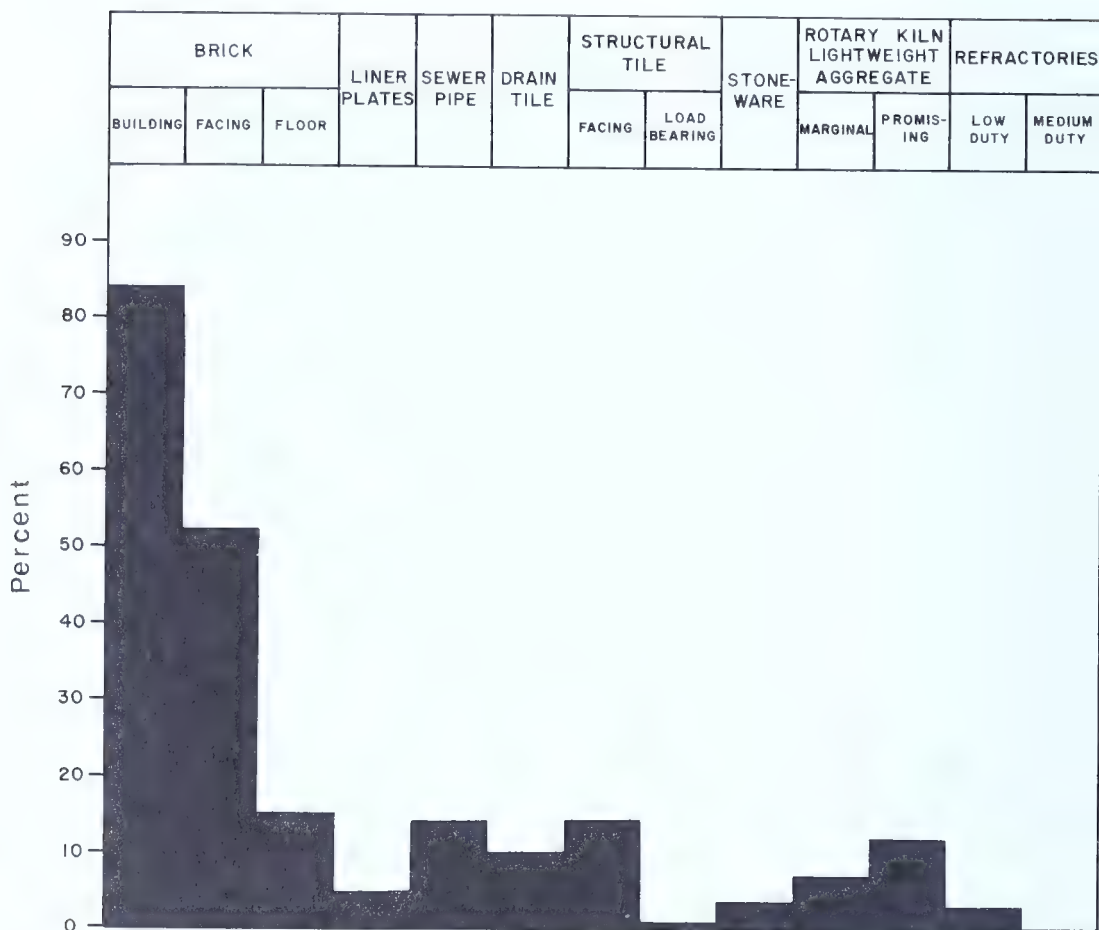


Figure 5. Percent of total number of samples (413) suitable for each use.

stratigraphic units considered to be good exploration targets for each use. The guidelines used to identify these exploration targets for most uses were: (1) the geologic units to be considered were restricted to those identified as intervals or subdivisions of intervals in Table 18; (2) the interval or its subdivision had to be represented by a minimum of five samples; and (3) the percent of samples showing a potential for the indicated use had to represent at least two samples.

For refractories, the third guideline was not applied. Furthermore, the number of exploration targets shown for refractories in Table 18 was expanded to include four other underclay or clay horizons. This expansion was based upon the results of studies by O'Neill (1976), Hosterman (1972), and Shaw (1928), in which four units in places within southwestern Pennsylvania were reported to contain flint and semiflint clay that could be used in making refractory clay products. These four units are: (1) the Bolivar clay (Freeport Formation, Allegheny Group); (2) the Upper Kittanning underclay (Kittanning Formation, Allegheny Group); (3) the Clarion underclay

(Clarion Formation, Allegheny Group); and (4) the Mercer underclay (Pottsville Group). The positions of these units in the stratigraphic column are shown on Plate 1.

For lightweight aggregate, the six units showing the highest combined percents for marginal and promising lightweight aggregate were selected as exploration targets.

Building Brick

Seven stratigraphic intervals represented by at least five samples showed 100 percent potential as raw material for building brick. These intervals were: (1) the Upper Freeport underclay in the Freeport Formation (subdivision of interval Q in the stratigraphic column on Plate 1); (2) the lower part of the Pittsburgh Formation (interval I); (3) the interval between the Upper Bakerstown coal and the top of the Buffalo sandstone in the Glenshaw Formation (interval N); (4) the Brush Creek shale interval in the Glenshaw Formation (interval O); (5) the shales and clays above the Sewickley coal in the Pittsburgh Formation (interval G); and (6) the Lower Freeport underclay in the Freeport Formation (subdivision of interval R). Many other intervals had a very high percent of samples that tested satisfactorily for raw material for building brick, indicating that numerous good exploration targets exist.

Facing Brick

Five good exploration targets are defined by the results of this study. They are: (1) the Clarion underclay in the Clarion Formation (upper part of interval X in the stratigraphic column on Plate 1); (2) the Brookville underclay in the Pottsville Group (interval Y); (3) the Lower Kittanning underclay in the Clarion Formation (interval V); (4) the Upper Freeport underclay in the Freeport Formation (upper part of interval Q); and (5) the lower part of the Pittsburgh Formation (interval I). A high percent of samples from many other intervals met the specifications for raw material for facing brick. These intervals also should be regarded as exploration targets.

Floor Brick

The best exploration targets defined by the results of this study are: (1) the Washington Formation (interval C in the stratigraphic column on Plate 1); (2) the Glenshaw Formation (interval LL); (3) the Brush Creek shale in the Glenshaw Formation (interval O); and (4) the Casselman Formation (interval II).

Liner Plates

The three best exploration targets indicated by the results of this study are: (1) the Kittanning Formation (interval RR in the stratigraphic column

Allegheny		(?)	(?)	3	67	67						33
	Freeport	PP		6	83	17			17	17		17
		Q	Upper Freeport under-clay	14	100	79				36	14	7
			Shales and/or clay-stones	10	80	30			20	10		
		R	Lower Freeport under-clay	5	100	60				60	20	20
			Shales and/or clay-stones	9	78	67	11	11	11	44		44
		RR		6	67	67	17	33	50			
	Kittanning	S	Upper Kittanning underclay	12	83	75			17		50	8
		I	Shales and/or clay-stones	19	95	63	5	5	16	5		21
			Middle Kittanning underclay	12	75	75			8		50	8
	Clarion	U		20	80	70	5	5	15	10	5	10
UU			2	100	50						50	
V		Lower Kittanning underclay	14	86	79	7				57	43	
W			10	70	70	10	20	20	10		30	
Pottsville	X	Clarion underclay	7	100	86					86	14	
		Shales and/or clay-stones	9	56	44					11	11	
	Y	Brookville under-clay	5	80	80					80	60	
	Z	Shales, claystones, and underclays	6	17	50				17	17		
Mississippian	Mauch Chunk		1	100	100			100				
	Catskill		1									
Devonian	Scherr		1	100	100							

*Refer to the stratigraphic column on Plate I.

on Plate 1); (2) the Uniontown Formation (interval E); and (3) the shales and/or clays above the Clarion coal (interval W).

Sewer Pipe

The best four intervals for raw materials for sewer pipe are (1) the Kittanning Formation (interval RR in the stratigraphic column on Plate 1); (2) the Glenshaw Formation (interval LL); (3) the Washington Formation (interval C); and (4) the Uniontown Formation (interval E).

Drain Tile

The best three intervals for raw materials for the production of drain tile are: (1) the lower part of the Pittsburgh Formation (interval I in the stratigraphic column on Plate 1); (2) the upper part of the Glenshaw Formation (interval M); and (3) the shales and/or clays above the Sewickley coal in the Pittsburgh Formation (interval G).

Structural Tile—Facing

The three best exploration targets for raw materials for the production of structural facing tile are all underclays. They are: (1) the Clarion underclay in the upper subdivision of interval X in the Clarion Formation (stratigraphic column on Plate 1); (2) the Brookville underclay in the Pottsville Group (interval Y); and (3) the Lower Freeport underclay in the Freeport Formation (upper subdivision of interval R).

Structural Tile—Load Bearing

Only three intervals show one sample suitable as raw material for load-bearing structural tile but, in accordance with the guidelines, none of these are classified as good exploration targets.

Stoneware

Two exploration targets as defined in this study are: (1) the Brookville underclay in the Pottsville Group (interval Y in the stratigraphic column on Plate 1); and (2) the Lower Kittanning underclay in the Clarion Formation (interval V).

Lightweight Aggregate

The outstanding exploration target defined by the results of this study is the Brush Creek shale in the Glenshaw Formation (interval O in the stratigraphic column on Plate 1). Five other intervals that offer exploration pos-

sibilities for lightweight-aggregate materials are: (1) the shales and/or claystones above the Sewickley coal in the Pittsburgh Formation (interval G); (2) the Casselman Formation (interval II); (3) the Birmingham shales in the Casselman Formation (interval L); (4) the shales and/or claystones in the lower part of the Freeport Formation (subdivision of interval R); and (5) the shales and/or claystones above the Middle Kittanning coal in the Kittanning Formation (subdivision of interval T).

Refractories

Exploration targets for refractories are restricted to the underclays in the Allegheny and Pottsville Groups. The results of this study identify some of these underclays. They are the Lower Freeport, the Middle Kittanning, and the Lower Kittanning in the Allegheny Group and the Brookville in the Pottsville Group. Based upon the results of studies by O'Neill (1976), Hosterman (1972), and Shaw (1928), four other underclays or clay horizons should also be classified as exploration targets because, in places in southwestern Pennsylvania, they contain flint or semiflint clay that can be used in the production of refractory clay products. They are (1) the Bolivar clay in the Freeport Formation (interval Q); (2) the Upper Kittanning underclay in the Kittanning Formation (interval S); (3) the Clarion underclay in the Clarion Formation (interval X); and (4) the Mercer underclay in the Pottsville Group (interval Z).

MINERALOGICAL CORRELATIONS

INTRODUCTION

Workers in previous attempts to correlate the mineralogy of Pennsylvania shales and clays with use (O'Neill and others, 1965, p. 410-422; Hoover and others, 1971, p. 305-308) found some restrictions in concentration ranges of certain minerals for some uses. Mineralogy could be a major factor in controlling the potential uses of a raw material, but evaluation of this factor has been hampered in the past by (1) difficulties involved with quantitative X-ray diffraction (see "Quantitative X-ray Mineralogy"); (2) an insufficient number of samples to precisely define the mineralogical ranges of many uses; (3) the inability to evaluate fully the effect of combinations of minerals in determining the properties of a sample and, hence, its use.

In this study the attempt to relate use to mineralogy was continued, but the following changes were made:

(1) The method of mineral quantification was revised (see "Quantitative X-ray Mineralogy"), and, for the first time, the percent of calcite was included in the routine procedure.

(2) The number of samples studied was more than double that in either of the two previous studies. One obvious effect of this was to increase the range reported for each mineral (Table 19). This increase should allow better definition of the mineral range that can be tolerated for some uses.

Table 19. Means and Ranges of Minerals in Pennsylvania Shales and Clays, Given in Percent

	Statewide (151) (O'Neill and others, 1965)		S.E. Pa. (159) (Hoover and others, 1971)		S.W. Pa. (413) (This report)	
	Mean	Range	Mean	Range	Mean	Range
Quartz	38	27-48	31	15-50	24	7-76
Mica	39	25-52	41	20-56	53	0-80
Kaolinite	7	1-20	12	4-35	14	0-49
Chlorite-vermiculite	--	--	--	---	3	0-14
Feldspar	2	1-8	2	1-11	3	0-15
Calcite	---	---	--	--	1	0-26
Montmorillonite	--	--	--	--	2	0-63
C-V-Mo*	5	1-12	9	4-14	5	--

* Chlorite-vermiculite-montmorillonite at assumed ratio of 4:2:1 for O'Neill and others (1965) and Hoover and others (1971); total of chlorite, vermiculite, and montmorillonite for this report.

(3) The use of an Olivetti P602 microcomputer, not previously available, allowed statistical comparison of each potential use with each mineral.

(4) The comparison of combinations of minerals with uses was not carried out; however, a more complete data base from which such studies could be carried out in the future was generated.

The mean and standard deviation for the percent of each mineral for all 413 samples and the mean percent for each use are listed in Table 20. Diagrams showing the mean concentration, the standard deviation, and range in amount of each mineral that can be tolerated for each use are also presented (Figures 6 through 9). It should be emphasized that these do not take into account the effects of combinations of minerals, which might modify the range over which a single mineral might be tolerated.

BUILDING BRICK

About 84 percent of the samples tested showed potential for use as building brick. The average mineral composition of these samples is similar to that for all 413 samples, and an extremely wide range of compositions is tolerated. The entire range of concentration found for all minerals other than quartz and calcite could be tolerated for this use.

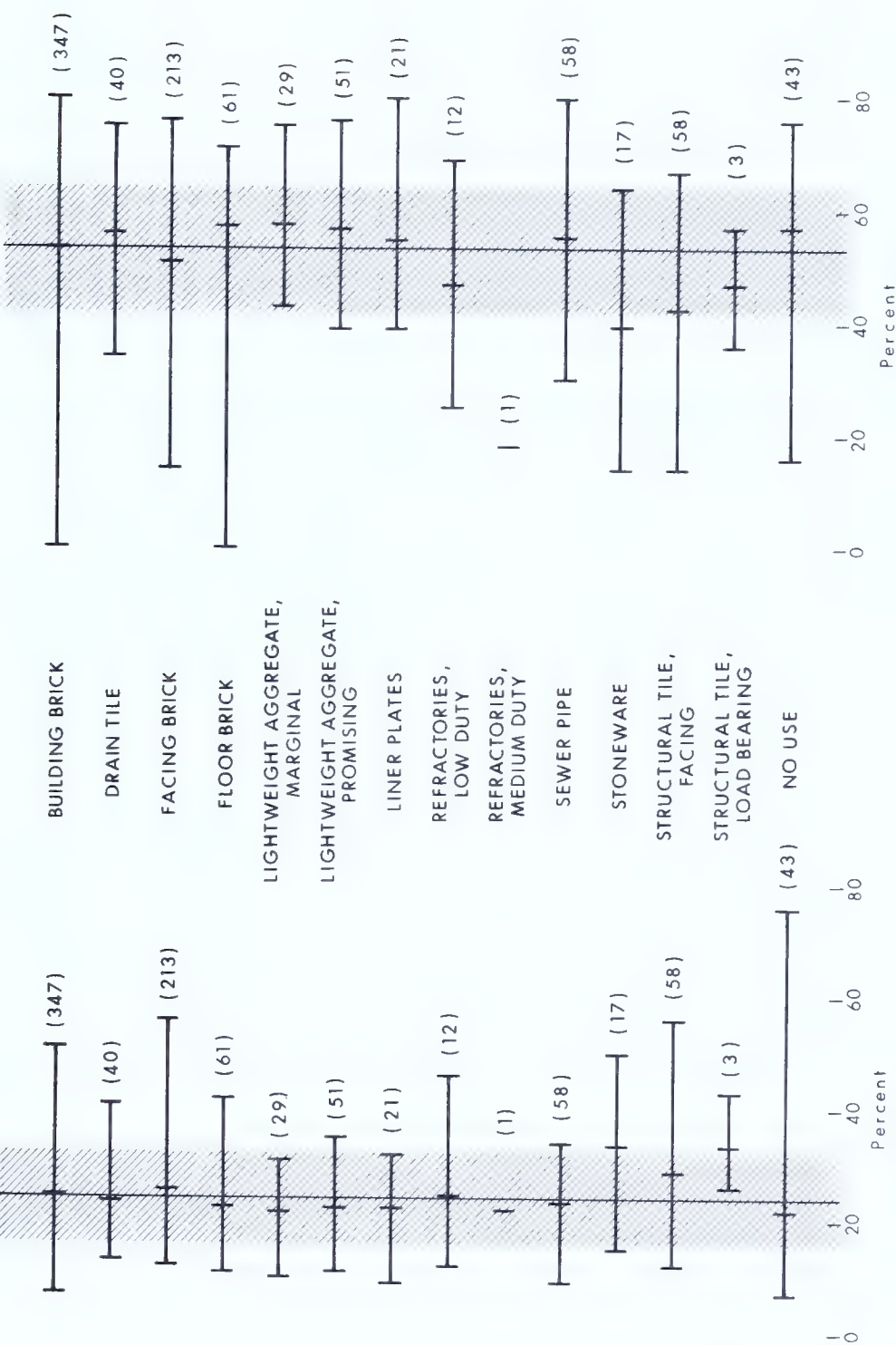


Figure 6. Range and mean of quartz concentration (in percent) and range and mean of mica concentration (in percent) for each use. The shaded zone indicates the mean and standard deviation of concentration for all samples. The number of samples for each use is indicated by the number in parentheses.

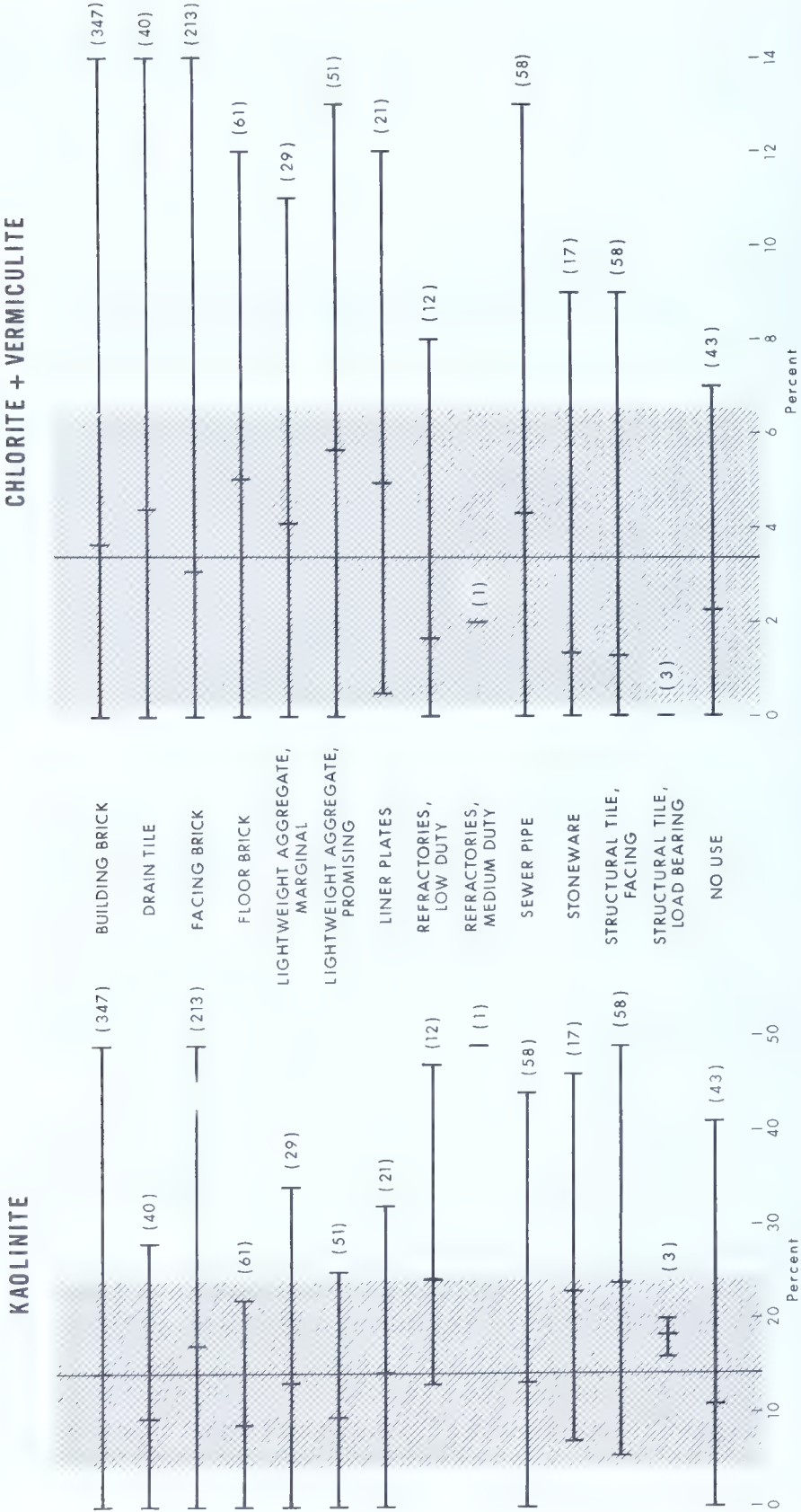
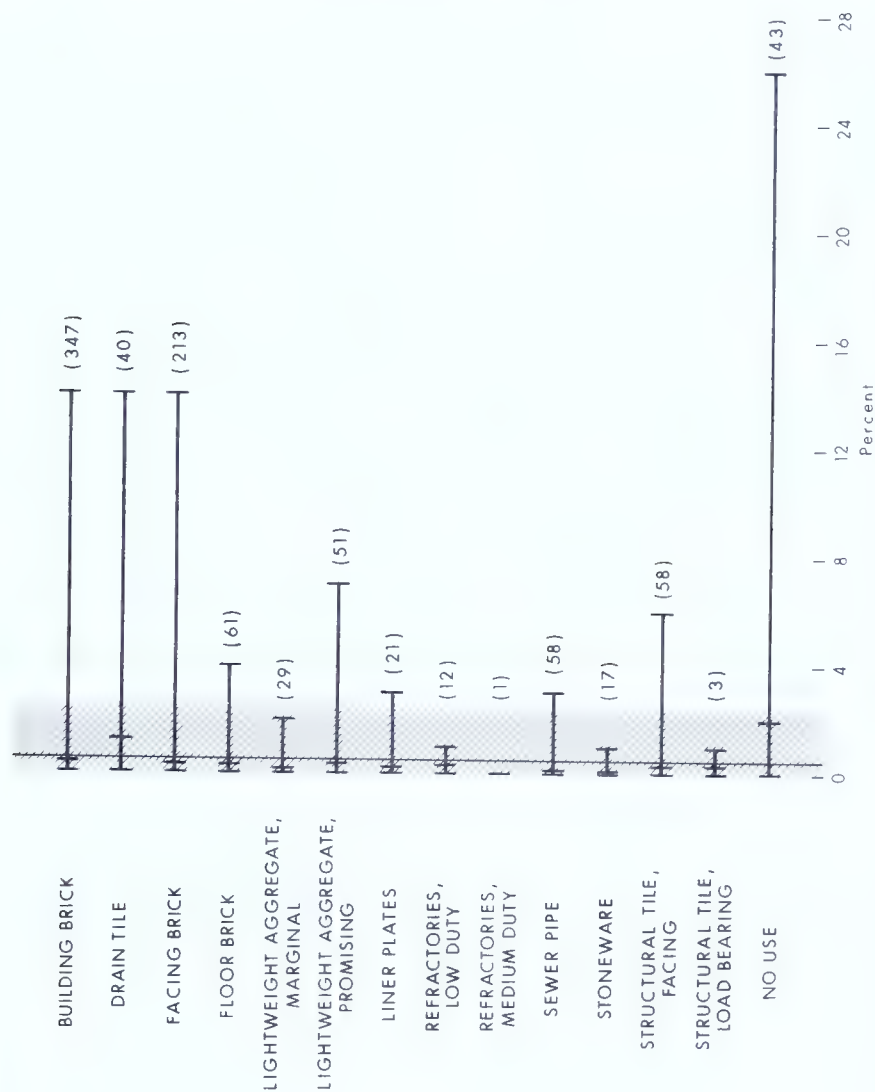


Figure 7. Range and mean of kaolinite concentration (in percent) and range and mean of concentration of chlorite plus vermiculite (in percent) for each use. The shaded zone indicates the mean and standard deviation of concentration for all samples. The number of samples for each use is indicated by the number in paren-

CALCITE



FELDSPAR

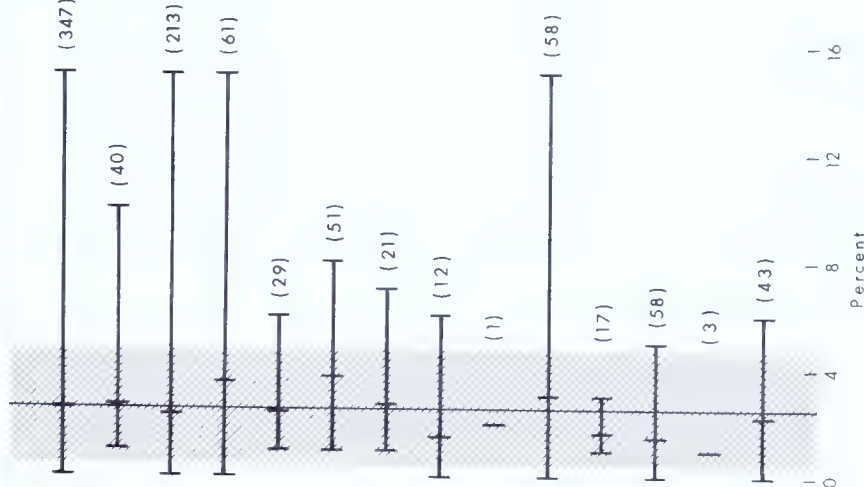


Figure 8. Range and mean of feldspar concentration (in percent) and range and mean of calcite concentration (in percent) for each use. The shaded zone indicates the mean and standard deviation of concentration for all samples. The number of samples for each use is indicated by the number in parentheses.

MONTMORILLONITE

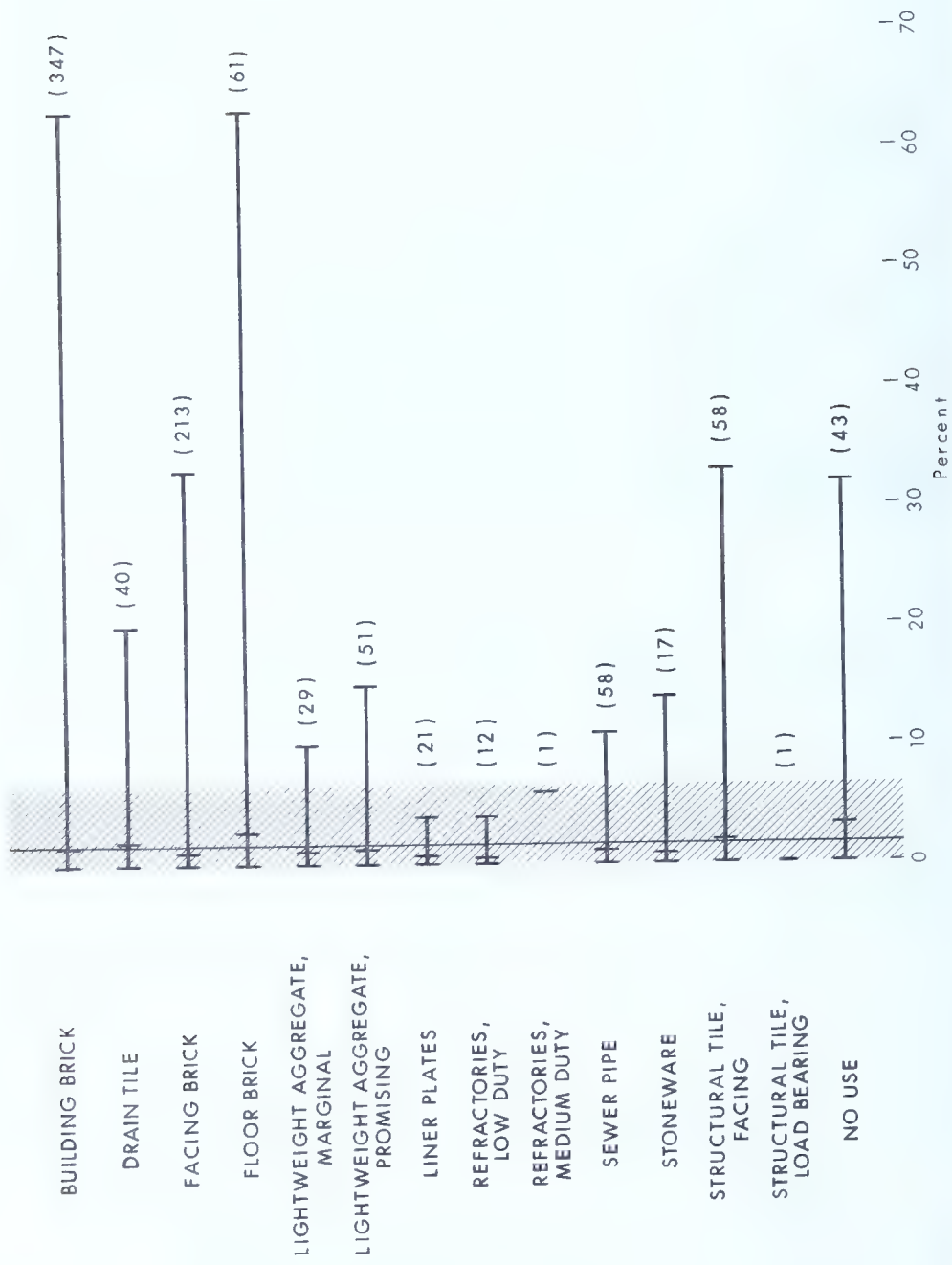


Figure 9. Range and mean of montmorillonite concentration (in percent) for each use. The shaded zone indicates

DRAIN TILE

The 40 samples indicated to have potential use as drain tile also have an average composition similar to that of all samples. The range of each mineral that can be tolerated, however, is more restricted than for building brick, although this could be caused by the smaller number of samples found with this use.

FACING BRICK

Slightly more than one half of the samples show potential for use as facing brick. The average composition is similar to that of all samples, and the compositional range is similar to that of building brick.

FLOOR BRICK

Floor brick, a potential use for 61 samples, shows an average composition similar to that for all 413 samples. The maximum amount of kaolinite, however, is 22%, considerably less than the maximum tolerated for most other uses. The maximum calcite found (4%) is also much less than for other kinds of brick.

LIGHTWEIGHT AGGREGATE

The 29 samples showing potential for marginal lightweight aggregate and the 51 showing potential for promising lightweight aggregate have an average composition similar to that of all samples.

LINER PLATES

The average composition of the 21 samples showing potential for use as liner plate is similar to that of all samples. The maximum amount of montmorillonite found (4%) is less than that tolerated for most uses.

REFRACTORIES

The 12 samples that show potential for use as low-duty refractories are characterized by an average kaolinite content somewhat higher than that for most other uses, although one sample is as low as 13%, which is slightly below the average of all samples. The one sample listed for use as medium-duty refractory contains 49% kaolinite and only 18% mica.

SEWER PIPE

Fifty-eight samples were indicated as having potential as raw material for the manufacture of sewer pipe. The average composition of these samples is

similar to that of all samples studied. Most minerals exhibit a wide range of concentration, but calcite and montmorillonite are present only in relatively small quantities.

STONEWARE

The 17 samples indicated as having potential use in the manufacture of stoneware have a higher-than-normal average quartz content, although the range of concentration of this mineral is rather large. Most other minerals also show wide ranges, although calcite is restricted to less than 1%.

STRUCTURAL TILE—FACING

The 58 samples having potential for use as facing structural tile cover a wide range of compositions, although the average amount of kaolinite is slightly higher than normal.

STRUCTURAL TILE—LOAD BEARING

The three samples showing potential as load-bearing structural tile show near average composition for all minerals except quartz, which is above average.

NO USE

The average composition of those samples is similar to that of all samples, but two minerals exhibit extreme ranges that probably limit usefulness. Quartz has a maximum concentration of 76%, but no sample containing more than 56% quartz showed any use potential. The maximum amount of calcite detected was 26%, but use potential is restricted to samples having 15% or less.

SUMMARY

Desirable raw materials for refractories, stoneware, and both categories of structural tile show compositional ranges that are anomalous. However, the wide range of composition that can be tolerated for most uses, plus the overlap of ranges for nearly all uses, severely limits the use of mineralogy as an exploration tool. It is only in samples in which one component is near an extreme of its composition range that possible relationships between mineralogy and use can be demonstrated.

CHEMICAL CORRELATIONS

INTRODUCTION

Past attempts to relate chemistry to use have met with mixed results (O'Neill and others, 1965, p. 426-433; Hoover and others, 1971, p. 311-

317). In this report, individual comparison is made for each use versus the major and minor elements (expressed as the oxides SiO_2 , TiO_2 , Al_2O_3 , total Fe as Fe_2O_3 , MgO , CaO , Na_2O , and K_2O), the ratios $\text{Fe}_2\text{O}_3/\text{FeO}$ and $\text{K}_2\text{O}/\text{Na}_2\text{O}$, and pH. The data required to calculate the ratio $\text{Fe}_2\text{O}_3/\text{FeO}$ were available only for 160 samples. TiO_2 was considered only for the other 253 samples because of computer limitations.

The average (mean) chemical composition of samples found suitable for each use is presented in Table 20, as are the average composition and variability for the total 413 samples. The range and mean of composition for each use are presented in Figures 10 through 15.

As with mineralogy, the correlations presented are simple 1:1 comparisons of use versus percent oxide to try to pinpoint components that could be essential or detrimental to a particular use. As will be pointed out, many of the findings parallel the findings of the mineralogical correlations.

BUILDING BRICK

The 347 samples having potential use as building brick have an average composition similar to that of all 413 samples. The range of concentration of each component is very broad, usually covering the entire range detected for all samples.

DRAIN TILE

The 40 samples designated as potential raw material for drain tile also have an average composition and pH similar to those of all 413 samples. The ranges of concentration of most components are less than those of building brick, but this could be a function of the much smaller number of samples.

FACING BRICK

The 213 samples showing potential use for facing brick have a near average composition and a wide range of composition that is only slightly more restricted than that of building brick.

FLOOR BRICK

Floor brick was designated as a potential use for 61 samples. These samples have an average composition that is near the average of all 413 samples and a moderate to wide range for all components.

LIGHTWEIGHT AGGREGATE

Twenty-eight samples were designated as potential marginal lightweight aggregate and 51 as promising lightweight aggregate. Those indicated as

Table 20. Mean Concentration of Minerals, Most Elements and pH for Each Potential Use, and Means and Standard Deviations for All Samples*

Number of samples:	Mean		Std. dev.		(347)	Bldg. brick	Drain tile	Facing brick	Floor brick	Lt. Aggr.—marginal	Lt. Aggr.—promising	Liner plates	Refrac., low-duty	Refrac., med.-duty	Sewer pipe	Stone-ware	Structural tile—facing	Structural tile—ld. brg.	No use
	(347)	(40)	(213)	(61)															
Quartz	24.11	8.08	24.29	23.75	25.43	22.50	21.82	22.18	22.28	24.91	22.00	23.18	33.58	28.91	33.33	21.83			
Mica	53.09	11.50	53.17	55.85	50.72	57.11	57.28	56.90	54.76	46.91	18.00	55.05	39.52	42.72	47.00	57.14			
Kaolinite	14.25	9.90	14.17	9.45	17.19	8.72	13.10	9.52	14.33	24.08	49.00	13.29	22.94	23.80	18.33	11.00			
Chlorite-vermiculite	3.40	3.14	3.67	4.40	3.08	5.04	4.10	5.66	4.95	1.66	2.00	4.31	1.35	1.29	0.00	2.26			
Feldspar	2.55	2.08	2.58	2.65	2.35	3.55	2.42	3.76	2.76	1.50	2.00	3.01	1.64	1.52	1.00	2.21			
Calcite	0.53	1.86	0.42	1.22	0.33	0.27	0.17	0.38	0.23	0.33	0.00	0.17	0.11	0.32	0.33	1.97			
Montmorillonite	1.70	4.95	1.53	1.97	1.07	2.78	1.10	1.38	0.71	0.50	6.00	1.03	0.94	1.98	0.00	3.28			
pH	6.76	1.71	6.74	7.45	6.48	7.09	6.91	7.27	7.08	4.86	5.60	7.06	5.40	5.80	5.53	7.03			
SiO ₂	57.59	6.18	57.88	55.57	58.93	57.43	55.75	56.71	58.01	58.48	51.20	58.37	64.66	61.11	64.53	54.45			
TiO ₂ †	1.02	0.22	1.04	1.00	1.11	0.94	0.96	0.91	0.99	1.90	1.60	1.00	1.34	1.29	1.07	0.94			
Al ₂ O ₃	19.30	2.78	19.40	18.16	19.86	19.29	18.88	18.83	19.21	22.74	33.50	18.93	20.87	21.06	19.16	17.92			
Fe ₂ O ₃ (total Fe)	6.37	2.52	6.43	7.15	5.72	7.47	7.80	7.52	7.47	2.98	2.10	7.35	2.30	3.23	2.58	6.61			
Fe ₂ O ₃ /FeO†	2.21	3.30	1.97	0.70	2.01	2.85	1.50	1.69	1.02	1.99	—	2.93	1.89	2.87	—	2.49			
MgO	1.46	0.54	1.47	1.68	1.29	1.71	1.71	1.89	1.60	0.70	0.70	1.54	0.77	0.84	0.73	1.58			
CaO	1.11	2.21	0.88	1.74	0.60	0.73	0.57	1.12	0.51	0.26	0.27	0.60	0.16	0.46	0.18	3.39			
Na ₂ O	0.35	0.27	0.35	0.43	0.31	0.47	0.48	0.55	0.38	0.18	0.15	0.41	0.18	0.20	0.16	0.32			
K ₂ O	3.00	0.59	3.00	2.94	2.92	3.15	3.25	3.22	3.12	2.22	1.42	3.10	2.55	2.61	2.93	3.04			
K ₂ O/Na ₂ O	12.22	6.47	12.16	10.29	13.19	9.82	10.91	9.10	10.40	12.36	9.46	10.79	14.89	14.37	18.21	11.49			

* Numbers in italics indicate mean greater than one standard deviation below average of all samples. Numbers in bold indicate mean greater than one standard deviation above average of all samples.

† TiO₂ data correlated only for 253 samples because of computer limitations.

‡ Fe₂O₃/FeO data only available for 160 samples.

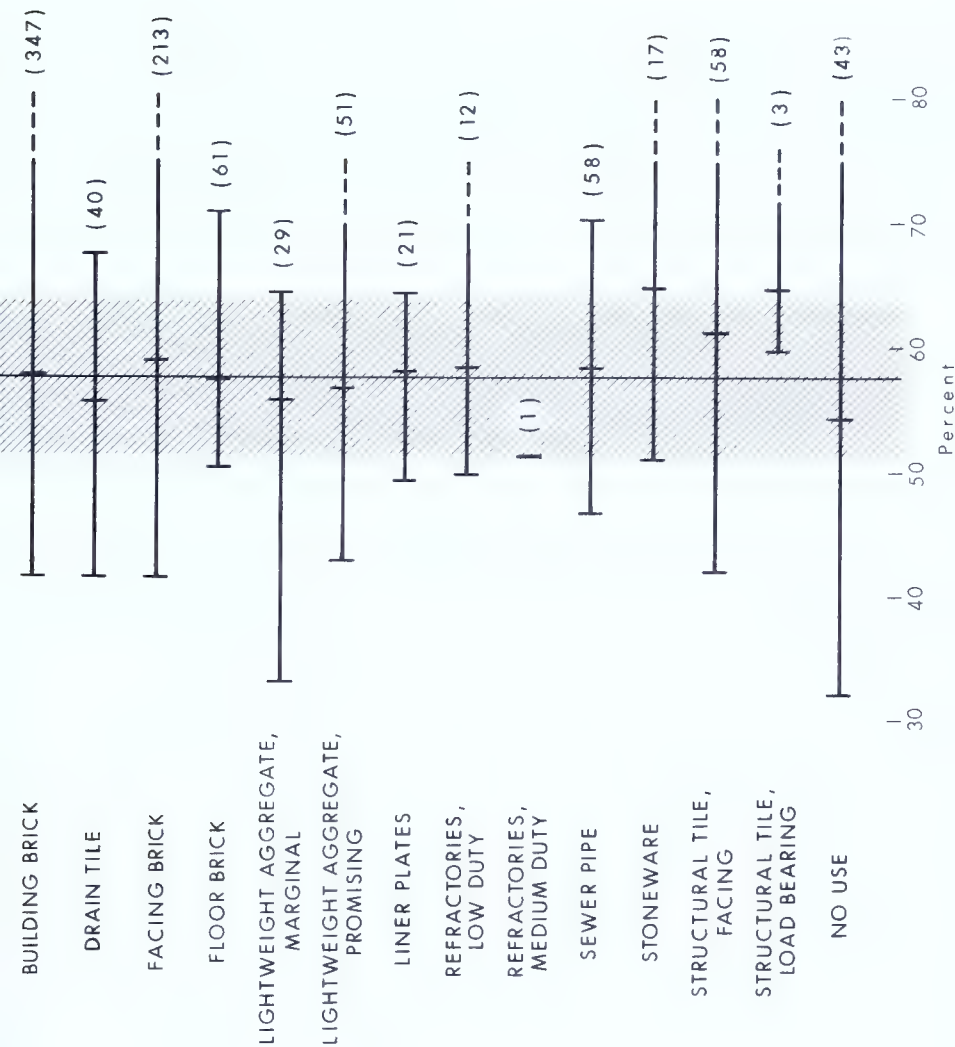


Figure 10. Range and mean of SiO₂ concentration (in percent) for each use. The shaded zone indicates the mean and standard deviation of concentration for all samples. The number of samples for each use is indicated by the number in parentheses.

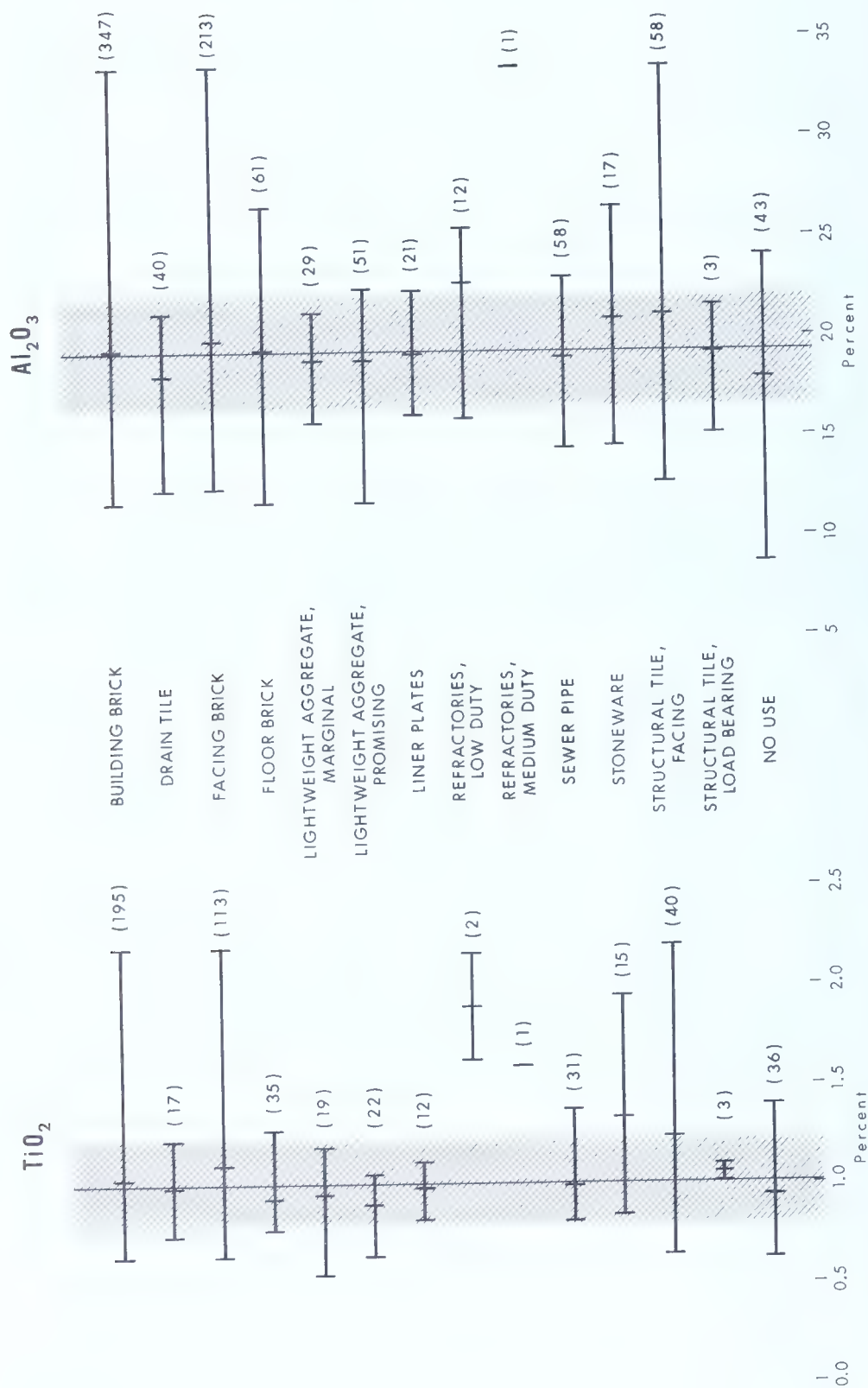


Figure 11. Range and mean of TiO₂ concentration (in percent) and range and mean of Al₂O₃ concentration (in percent) for each use. The shaded area indicates the mean and standard deviation of concentration for 253 samples for TiO₂ and for all samples for Al₂O₃. The number of samples for each use is indicated by the

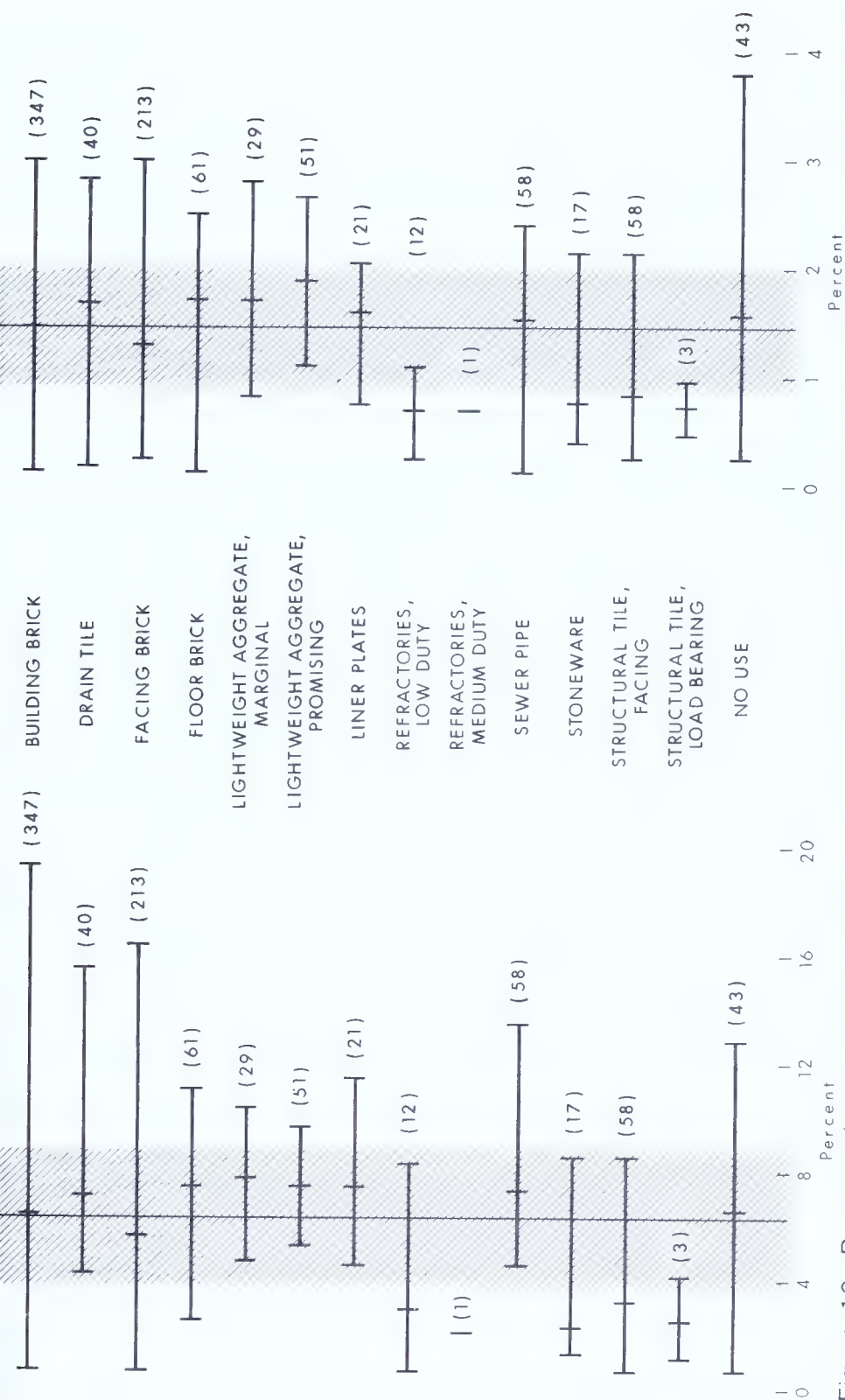


Figure 12. Range and mean of total FeO expressed as Fe_2O_3 (in percent) and range and mean of MgO concentration (in percent) for each use. The shaded area indicates the mean and standard deviation of concentration for all samples. The number of samples for each use is indicated by the number in parentheses.

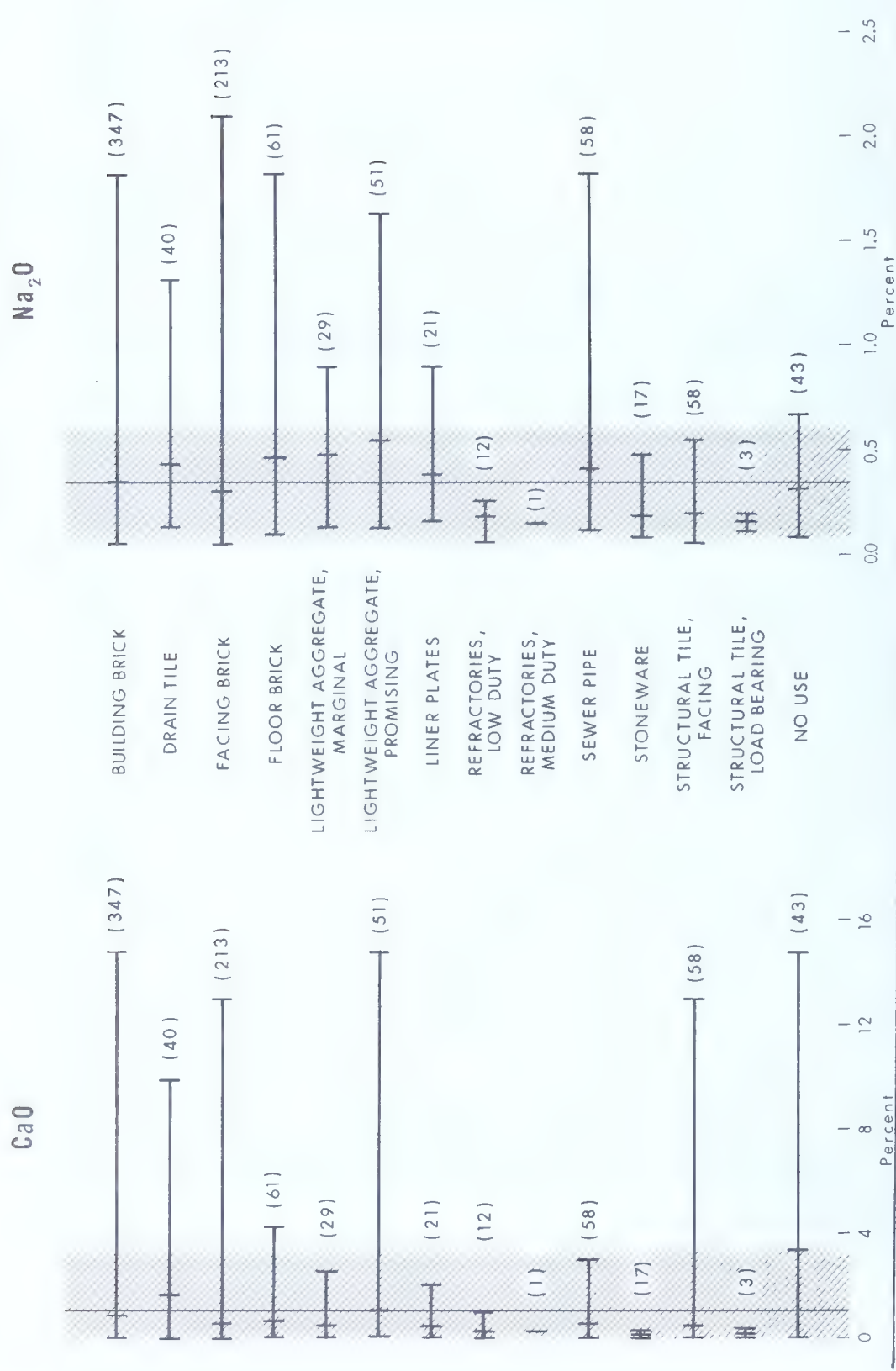


Figure 13. Range and mean of CaO concentration (in percent) and range and mean of Na₂O concentration (in percent) for each use. The shaded area indicates the mean and standard deviation of concentration for all samples. The number of samples for each use is indicated by the number in parentheses.

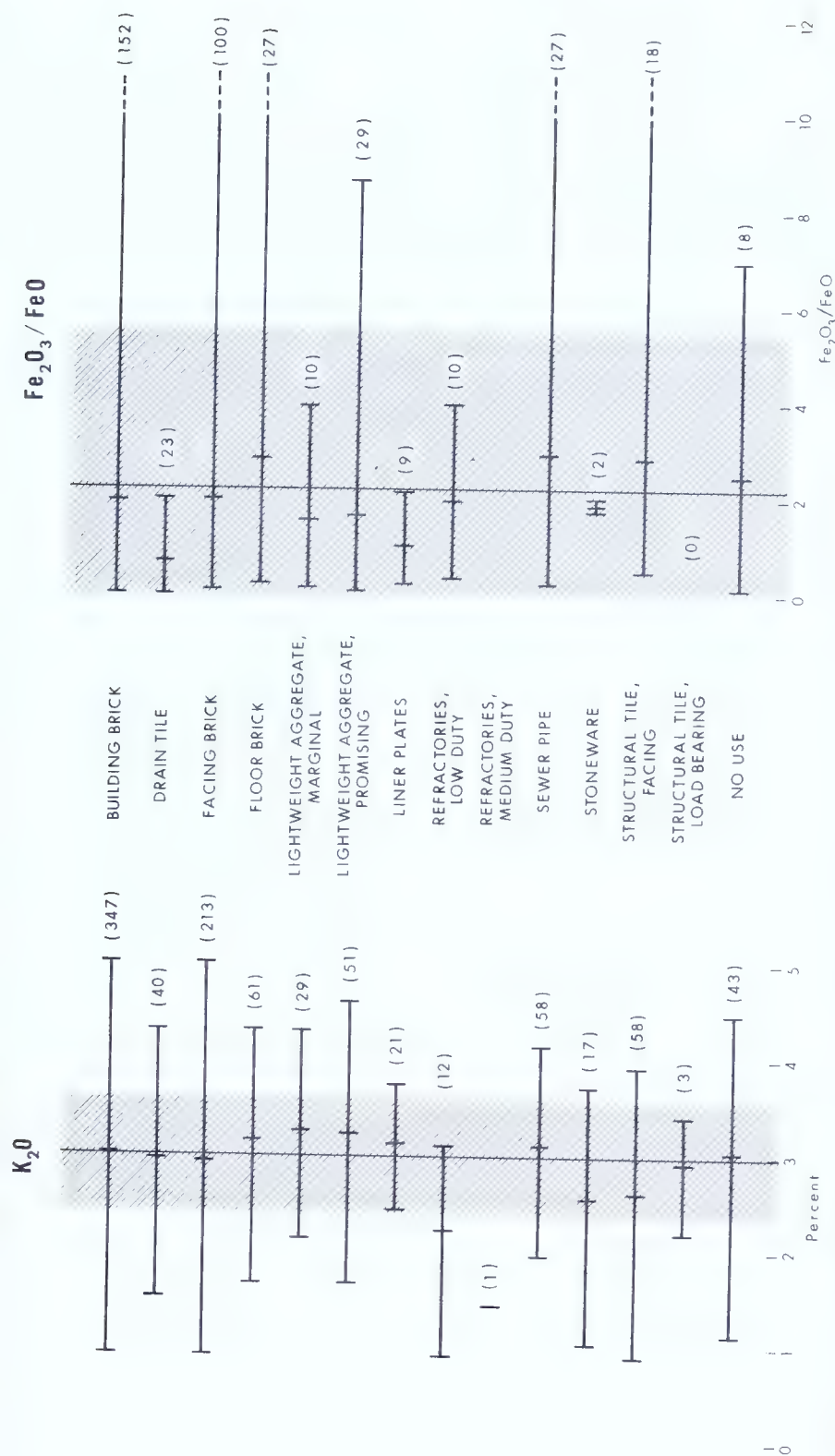


Figure 14. Range and mean of K₂O concentration (in percent) and range and mean of Fe₂O₃/FeO ratio for each use. The shaded area indicates the mean and standard deviation of K₂O for all samples and of Fe₂O₃/FeO for 160 samples. The number of samples for each use is indicated by the number in parentheses.

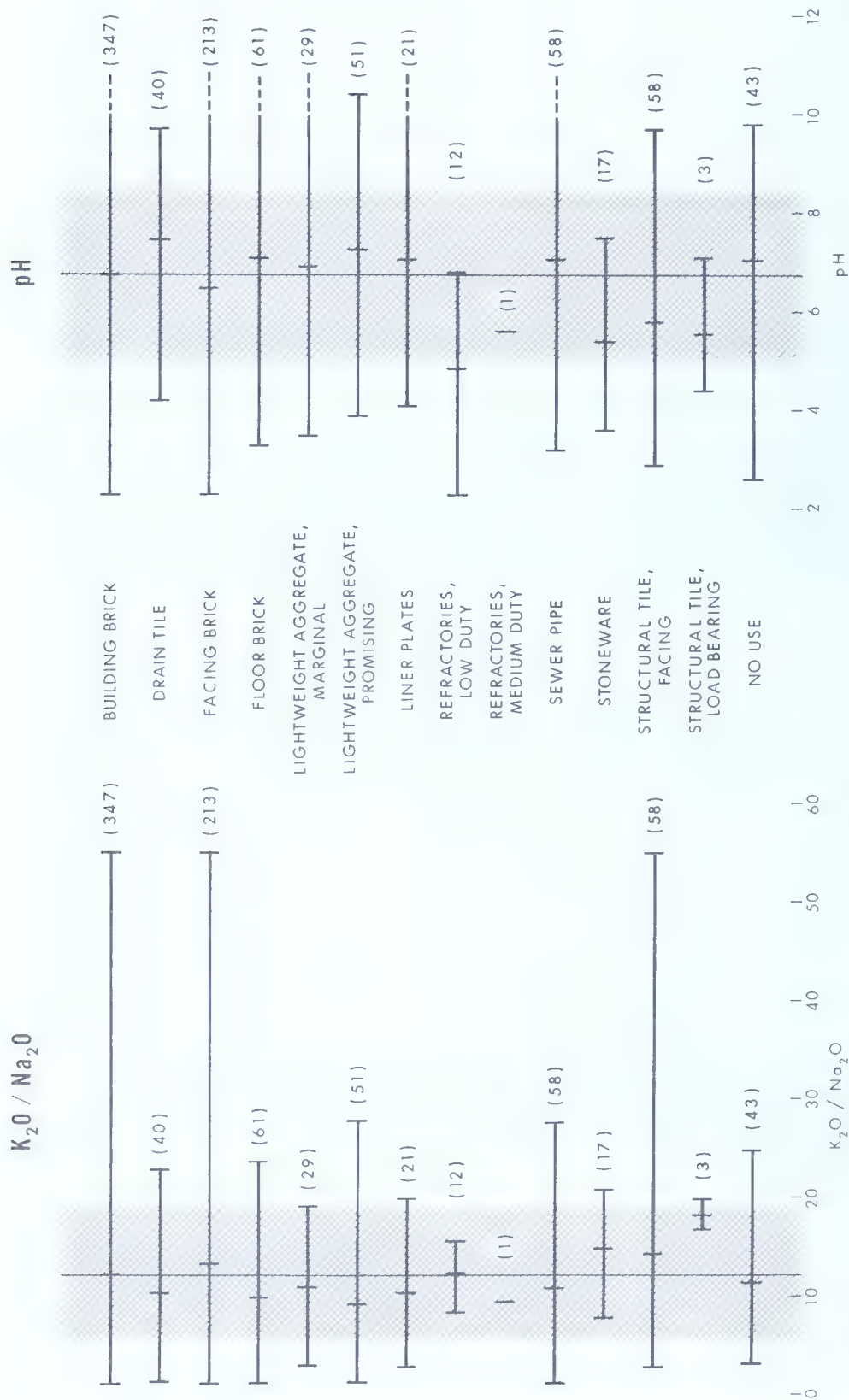


Figure 15. Range and mean of K_2O/Na_2O ratio and range and mean of pH for each use. The shaded area indicates the mean and standard deviation for all samples. The number of samples for each use is indicated by the

promising have a much larger range of CaO (0.12 to 14.80%) than the marginal samples (0.08 to 2.60%). A less dramatic, but similar, trend is noted for calcite, suggesting that the superior performance of at least some of the promising samples might be attributed to evolution of CO_2 from CaCO_3 . Other elements appear to have near average concentrations, although the minimum amount of SiO_2 tolerated for marginal lightweight aggregate (33%) is about 10 percentage points below that for any other use.

One-hundred sixty samples included in this report were studied previously by O'Neill (1976, p. 58), who attempted to relate promising lightweight aggregate samples to chemistry by plotting composition on triangular diagrams using major fluxing oxides (CaO , MgO , Fe_2O_3 , K_2O , and Na_2O) as one apex, $\text{C} + \text{CO}_2 + \text{S}$ or $\text{C} + \text{CO}_2 + \text{S} + \text{combined H}_2\text{O}$ as another, and other components as the third. Although a small field containing only promising lightweight-aggregate samples was delineated, most of the samples fell into a mixed field of good bloaters and nonbloaters.

LINER PLATES

For nearly every parameter, the 21 samples selected as potential raw material for liner plates correspond very closely with the average of the 413 samples. The only exception is a below average range for $\text{Fe}_2\text{O}_3/\text{FeO}$, which has a maximum of only 2.15.

REFRACTORIES

The 13 samples designated as having potential use as refractories have a relatively high average concentration of Al_2O_3 , paralleling an anomalously high concentration of kaolinite. The potential low-duty refractories, however, include samples having Al_2O_3 contents covering the entire range within, and slightly below, one standard deviation of the mean of all 413 samples. Despite these results, it is anticipated that the percent of Al_2O_3 would be an important factor for medium- and high-duty refractories.

Three of the 13 samples showing potential for refractories were checked for TiO_2 , which greatly exceeded the average range in the 253 samples for which TiO_2 data were correlated, probably reflecting the presence of anatase or rutile in the residual clay deposits. Refractories have relatively low average concentrations of total Fe, MgO , and K_2O , although the ranges are broad enough to overlap most other uses. The 12 low-duty samples have a below average pH. The minimum pH tolerated is 2.3, considerably lower than that tolerated for any other use except building brick and facing brick. The upper limit is 6.8.

SEWER PIPE

Fifty-eight samples were designated as having potential as raw material for the manufacture of sewer pipe. These samples have an average composi-

tion similar to that of all 413 samples and moderate to large ranges for all components.

STONEWARE

The 17 samples designated for use as stoneware show an anomalously high average value for SiO_2 , which supports the mineralogic data showing high average concentration of quartz. The range for SiO_2 , however, extends to a minimum of 51.00% so that overlap exists with nearly every other potential use. The average values for total Fe and for MgO are low, but the samples cover a wide range of concentration. The CaO tolerated ranges from 0 to 0.3%, which must be classified as quite restricted, considering the number of samples involved. The pH is also somewhat restricted, having a maximum of 7.5.

STRUCTURAL TILE—FACING

The 58 samples designated for use as facing structural tile have a wide range of concentration for many elements. The average concentration of TiO_2 is high, although it has a wide range that extends to a minimum of 0.85%. The Ti might be present as anatase or rutile, which have been found in residual clay deposits in Centre County (Hosterman, 1973). The Al_2O_3 range for this use is slightly high, but wide, paralleling the findings for kaolinite. MgO and total Fe have average concentrations that are low, but exhibit rather wide ranges.

STRUCTURAL TILE—LOAD BEARING

The three samples indicated for potential use as load-bearing structural tile show relatively high values for SiO_2 and low values for total Fe and MgO.

NO USE

Forty-three samples showed no current potential use. The average composition of these samples is not greatly different from the average of all 413 samples, but some samples exhibit compositional extremes that may be diagnostic. The maximum amount of CaO in these samples is 14.80%, which is matched by two uses (building brick and lightweight aggregate) and approached by only two others (facing brick and facing structural tile). All other uses have much lower maximum amounts of CaO. Tested samples contain a minimum of 8.70% Al_2O_3 , but samples for which a use was found have a minimum of 11.75%, suggesting a minimum requirement for this element. A minimum requirement might also exist for SiO_2 in structural and ceramic uses, the minimum among samples indicated for these uses being

41.60%. Lightweight aggregate could be prepared from a sample having only 33.00% SiO₂. The minimum SiO₂ detected was 32.10% in a sample having no use. MgO also shows a range that extends beyond the maximum range of samples for which a use could be found.

SUMMARY

The results of correlation to use versus chemistry are very similar to those of use versus mineralogy, and essentially the same conclusions can be drawn. Some relationships between chemistry and use can be demonstrated, but the compositional range that can be tolerated for most uses is broad enough to overlap in almost every case. Thus, the determination of the chemical and mineralogical composition of clay and shale samples is of no practical application for those product uses studied. Physical and firing testing is the most reliable procedure, short of pilot plant studies, found for the evaluation of raw materials for these products.

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GLOSSARY

Each term in this glossary is defined primarily for its meaning in this report and is not to be considered a recognized standard.

- Absorption (percent).** The amount of water absorbed by a sample, expressed as a percent of the dry weight of that sample.
- Anticline.** A fold that is convex upward; the core of the anticline contains the stratigraphically older rocks.
- A.S.T.M.** American Society for Testing Materials.
- Atomic absorption analysis.** The quantitative determination of a chemical element in a sample, performed by measurement of the amount of light of a characteristic wavelength that is absorbed as it passes through sample material atomized in a flame.
- Bloating.** The ability of clay-shale fragments to expand twice or more times their original volume during fairly rapid firing. Bloating results from the entrapment of gases which are evolved during firing. The material must have adequate viscosity to trap gas bubbles throughout the temperature of firing.
- Bloating range.** Temperature range in which clay or shale materials will bloat.
- Blocky fragment.** A fragment in which all axes are approximately equal in length; the thickness of the fragment exceeds 1/2 inch (1.3 cm).
- Cement rock.** A clayey limestone that has the necessary chemical composition to be manufactured into cement without the addition of other materials.
- Chamosite.** An iron-rich species of the chlorite group.
- Channel sample.** A sample consisting of material collected from a narrow channel cut continuously through a sequence of beds; the channel is oriented normal to the bedding.
- Chippy fragment.** A fragment in which one axis is shorter than the other two axes; the thickness of the fragment is less than 1/2 inch (1.3 cm).
- Chlorite.** A group having the general formula $M_{5-6}(Al,Si)_4O_{10}(OH)_8$, in which M can be Mg, Fe^{+2} , Fe^{+3} , Al, etc. (Fleischer, 1975); species of chlorite are undifferentiated in this study.
- Clay.** An earthy, extremely fine grained, natural sediment or soft rock composed primarily of clay-sized particles.
- Clay mineral.** A hydrous aluminosilicate mineral that crystallizes in a layered structure and forms minute, flake-like particles. The term

“clay” is usually restricted by geologists to particles less than 4 microns in diameter.

Claystone. An indurated clay having the texture and composition of shale but lacking its fine lamination or fissility.

Conglomerate. A coarse-grained clastic sedimentary rock that is the consolidated equivalent of gravel, both in size range and in the essential roundness and sorting of its constituent particles.

Differential thermal analysis (DTA). A mineral identification technique that measures the characteristic temperatures at which chemical reactions occur, and the heat of reaction, as a sample is heated.

Dip. The angle that a structural surface, e.g., a bedding plane, makes with the horizontal.

Dry strength. The apparent strength of a clay and shale briquette after drying at 110°C as determined by visual inspection.

Drying shrinkage. The amount of shrinkage in a clay after it has been air-dried for 24 hours and oven-dried at 110°C for an additional 24 hours.

Effervesce. To bubble, hiss, and foam as gas escapes.

Efflorescence. A discoloration that appears on the surface of clay products due to soluble salts.

Equant fragment. A fragment in which all axes are approximately equal in length; the thickness of the fragment is less than 1/2 inch (1.3 cm).

Exploration. The search for a sufficient quantity of a useful raw material or mineral prior to development into a commercial operation.

Exposure. An area or vertical wall where bedrock is visible, formed by either natural or artificial (man-made) means.

Fault. A fracture in rock along which there has been displacement.

Feldspar. A mineral group having the general formula $MAI(Al, Si)Si_2O_8$, in which M can be K, Na, Ca, etc. (Fleischer, 1975); species of feldspar are undifferentiated in this study.

Fire clay. A siliceous clay rich in hydrous aluminum silicates, capable of withstanding high temperatures without deforming.

Flaggy fragment. A fragment in which one axis is much shorter than the other two axes; the thickness of the fragment exceeds 1/2 inch (1.3 cm).

Flame emission. The quantitative determination of a chemical element in a sample performed by measuring the amount of light of a characteristic wavelength that is emitted by the sample when it is atomized in a flame.

Flint clay. A very hard, smooth, flintlike fireclay that breaks with a conchoidal fracture and that develops no plasticity when ground up.

Fold. Bending of the rock strata, usually a product of deformation.

Formation (geologic). A sequence of sedimentary beds that are characterized by a sufficient number of distinctive lithologic features to be mapped as a unit.

Grab sample. A sample collected randomly from an exposure or a stockpile.

- Hackly fragment.* A fragment in which all axes are unequal in length; the thickness of the fragment is less than 1/2 inch (1.3 cm).
- Illite.* A nonexpanding, three-sheet clay mineral, member of the mica group, having the formula $(K, H_3O)(Al, Mg, Fe)_2(Al, Si)_4O_{10}[(OH)_2, H_2O]$ (Fleischer, 1975), deficient in potassium as compared to nonclay members of that group such as muscovite.
- Indurated.* A term used to describe a compact rock that has been hardened by the action of pressure, cementation, and heat.
- Interference.* In X-ray diffraction (as used in text), the coincidence of diffraction peaks of two or more minerals at the same position, which makes it impossible to accurately measure either peak.
- Jigger.* A machine carrying a revolving mold in which the clay for ceramics is shaped by a profile.
- Joint.* A planar surface of actual fracture or break in a rock, in which no apparent displacement is involved.
- Kaolinite.* A nonexpanding, two-sheet clay mineral in the kaolinite-serpentine group, having the formula, $Al_2Si_2O_5(OH)_4$ (Fleischer, 1975); undifferentiated in this study from dickite and nacrite, also members of this group which have the same composition.
- Kiln.* A type of furnace used for processing a clay-shale material by firing.
- Laminated (thinly).* The thickness of the stratigraphic unit is less than 1/10 inch (0.3 cm); (*thickly*)—the thickness of the stratigraphic unit is between 1/10 and 2/5 inch (0.3 and 1.0 cm).
- Limestone.* A sedimentary rock consisting chiefly of calcium carbonate, with or without magnesium carbonate.
- Medium bedded.* The thickness of the stratigraphic unit is between 4 and 12 inches (10 and 30 cm).
- Mica.* As reported in sample data, any three-sheet, layered mineral producing X-ray diffraction at approximately 10.0 Ångströms. Includes well-crystallized species of true mica group (e.g., muscovite, biotite), as well as illite, and collapsed montmorillonite or montmorillonite-bearing mixed-layer materials.
- Mill scale.* A scaly coating that forms on the surfaces of a kiln during the heating process to manufacture cement.
- Mixed layer.* Any clay mineral that contains adjacent layers of different mineral species. A common form of mixed-layer material is one with adjacent layers of illite and montmorillonite.
- Montmorillonite.* A clay-mineral group having the general formula $X_{0.33}Y_2Si_4O_{10}(OH)_2 \cdot 4H_2O$ in which $X = Ca, Na$, and $Y = Al, Fe^{+3}, Cr, Mg, Ni, Zn, Li$ (Fleischer, 1975). The species of this group have a three-sheet, layered structure similar to that of illite and mica, but have loosely bound, exchangeable cations in the interlayer positions. This group is characterized by its ability to absorb and desorb water or cer-

tain polar organic molecules, such as ethylene glycol, between its layers, thus changing its basal dimension. (Syn.:smectite group.)

Munsell color system. A system of color classification that is applied in geology to the colors of rocks and soils. Color is defined by its hue, value or brilliance, and chroma (purity).

Papery fragment. A fragment in which one axis is much shorter than the other two axes; the thickness of the fragment does not exceed 1/32 inch (0.08 cm).

pH value. Measurement of relative acidity or alkalinity.

Physiographic province. A region whose pattern of relief features or landforms differs significantly from those of adjacent regions.

Plasticity. The property of a material to be molded easily yet capable of hardening into the desired fixed form.

Platy fragment. A fragment in which one axis is much shorter than the other two axes; the thickness of the fragment ranges from 1/32 inch (0.08 cm) to 1/2 inch (1.3 cm).

Porosity, apparent. The relationship of the open pore space in a material to its bulk volume, expressed in percent.

Pyrometric cone equivalent (P.C.E.). A measure of the ability of a clay-shale material to withstand heat, expressed in terms of standard pyrometric cones. More precisely, the number of the standard pyrometric cone that fails at the same temperature a cone made from a clay-shale material under investigation fails.

Quick-firing. A test in which a clay-shale sample is set in a refractory boat and placed in a preheated furnace to determine its bloating characteristics.

Representative sample. A sample collected normal to bedding at selected intervals so that the different materials involved are proportionately represented.

Rotary kiln. A kiln that rotates around its axis. The pilot-scale rotary kiln used to test clay-shale material for lightweight aggregate is 18 inches (45 cm) in diameter by 20 feet (6 m) and has a discharge slope of 1/4 inch per foot (0.6 cm/m).

Rubby fragment. A fragment in which all axes are unequal in length; the thickness of the fragment exceeds 1/2 inch (1.3 cm).

Sandstone. A clastic sedimentary rock composed predominantly of rounded or angular sand-sized particles that are usually quartz.

Sedimentary rock. A rock resulting from the consolidation of loose sediment that has accumulated in layers; consisting of mechanically formed fragments of older rock transported from its source and deposited in water or from air or ice; or a chemical rock (such as limestone) formed by precipitation from solution.

Shale. A fine-grained detrital sedimentary rock formed by the consolidation of clay or mud and characterized by thin bedding or fissility.

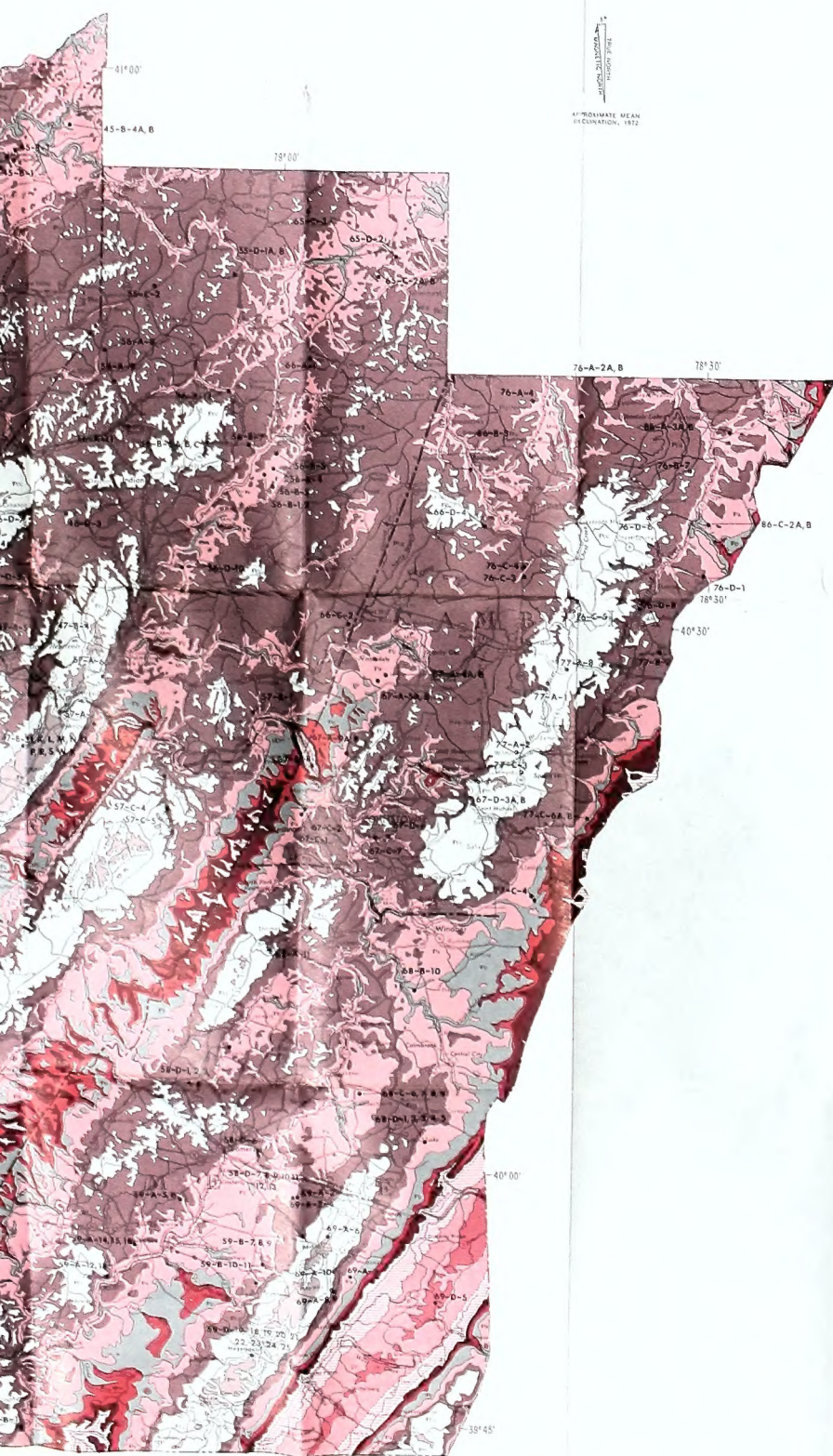
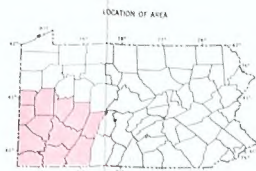
- Shrinkage.* To compact as a result of drying in air or firing in a furnace.
- Siltstone.* A sedimentary rock that is composed principally of silt-sized particles.
- Slabby fragment.* A fragment in which one axis is shorter than the other two axes; the thickness of the fragment is greater than 1/2 inch (1.3 cm).
- Slow firing.* Process of firing dried samples in a muffle furnace, starting from room temperature and raised to a selected temperature over a specific time interval.
- Soak.* A conditioning of ceramic ware to a uniform temperature.
- Splintery fragment.* A fragment in which one axis is much longer than the other two axes.
- Stiff mud.* A plastic mix of clay having a very stiff consistency, as extruded from an auger machine.
- Stoichiometry.* The degree to which a mineral contains the proportions of elements specified in its chemical formula.
- Strength (dry).* The ability to hold up or withstand handling. Classifications into different grades is done by visual examination.
- Thermogravimetric analysis (TGA).* A mineral identification technique that measures the characteristic changes in weight of a sample, and the temperatures at which the changes occur, as the sample is heated.
- Thick bedded.* The thickness of the stratigraphic unit is between 1 and 3 feet (30 and 100 cm).
- Thinly bedded.* The thickness of the stratigraphic unit is between 1 and 4 inches (3 and 10 cm).
- Underclay.* A layer of clay lying immediately beneath a coal bed or forming the floor of a coal seam.
- Vermiculite.* A mineral group having the general formula $(\text{Mg, Fe, Al})_2(\text{Al, Si})_4\text{O}_{10}(\text{OH})_2 \cdot 4\text{H}_2\text{O}$ (Fleischer, 1975); species of vermiculite are undifferentiated in this study.
- Very thickly bedded.* The thickness of the stratigraphic unit is greater than 3 feet (100 cm).
- Very thinly bedded.* The thickness of the stratigraphic unit is between 2/5 and 1 inch (1 and 3 cm).
- X-ray diffraction.* A mineral identification technique in which the apparent reflection of X-rays by a crystalline substance produces a characteristic pattern. Quantitative X-ray diffraction is a technique that compares the intensity to a known quantity of the mineral.
- X-ray diffractometer.* A laboratory device that measures the characteristic X-ray pattern of a mineral. See *X-ray diffraction*.
- Water of plasticity.* The amount of water that must be added to the clay or shale sample after it has been crushed in order to extrude briquettes in a laboratory-size hydraulic ram press.
- Workability.* The ability of a clay to be worked or formed by hand, expressed in terms of relative plasticity.

BY

1979



L. JR.



Virginia M. Milewski, Cartographer

SYSTEM	GROUP	THICKNESS (FEET)	FORMATION	INTERVAL	COLUMNAR SECTION	MEMBERS, BEDS, AND OTHER MINOR UNITS
QUATERNARY						Alluvium
Recent Pleistocene						Terrace deposit
Recent Illinoian and Wisconsin						Carmichaels Formation
PERMIAN	Dunkard	up to 150		A		Coal
			Greene <i>gr</i>	B		Upper Washington limestone
			Washington <i>ls</i>	C		Jollytown coal
PERMIAN AND PENNSYLVANIAN		885 (maximum)				Washington coal
			Waynesburg <i>ss</i>	CC		Little Washington coal
				DD		Waynesburg sandstone
PENNSYLVANIAN	Monongahela <i>ss</i>	240-500		E		Waynesburg coal
						Little Waynesburg coal
						Waynesburg limestone
						Uniontown sandstone
						Uniontown coal
	Pittsburgh			F		Waynesburg coal
						Little Waynesburg coal
						Waynesburg limestone
						Uniontown sandstone
						Uniontown coal
	Chautauque <i>ss</i>	500-960		EE		Waynesburg coal
						Little Waynesburg coal
						Waynesburg limestone
						Uniontown sandstone
						Uniontown coal
	Onondaga	220-320		G		Waynesburg coal
						Little Waynesburg coal
						Waynesburg limestone
						Uniontown sandstone
						Uniontown coal
DEVONIAN	Allegheny <i>ss</i>	120-250		H		Waynesburg coal
						Little Waynesburg coal
						Waynesburg limestone
						Uniontown sandstone
						Uniontown coal
	Pottsville <i>ss</i>	200-550		I		Waynesburg coal
						Little Waynesburg coal
						Waynesburg limestone
						Uniontown sandstone
						Uniontown coal
	Mauch Chunk	200-300		J		Waynesburg coal
						Little Waynesburg coal
						Waynesburg limestone
						Uniontown sandstone
						Uniontown coal
	Okehill <i>ss</i>	200-1900		K		Waynesburg coal
						Little Waynesburg coal
						Waynesburg limestone
						Uniontown sandstone
						Uniontown coal
	Frankford <i>ss</i>	~ 1500		L		Waynesburg coal
						Little Waynesburg coal
						Waynesburg limestone
						Uniontown sandstone
						Uniontown coal
	Schoen <i>ss</i>	~ 1500		M		Waynesburg coal
						Little Waynesburg coal
						Waynesburg limestone
						Uniontown sandstone
						Uniontown coal

